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A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

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By E. D. Gardner

The Law of Mines and the Freedom of the Miner
By T. A. Rickard

An Old Plan to Recover Gold in Place
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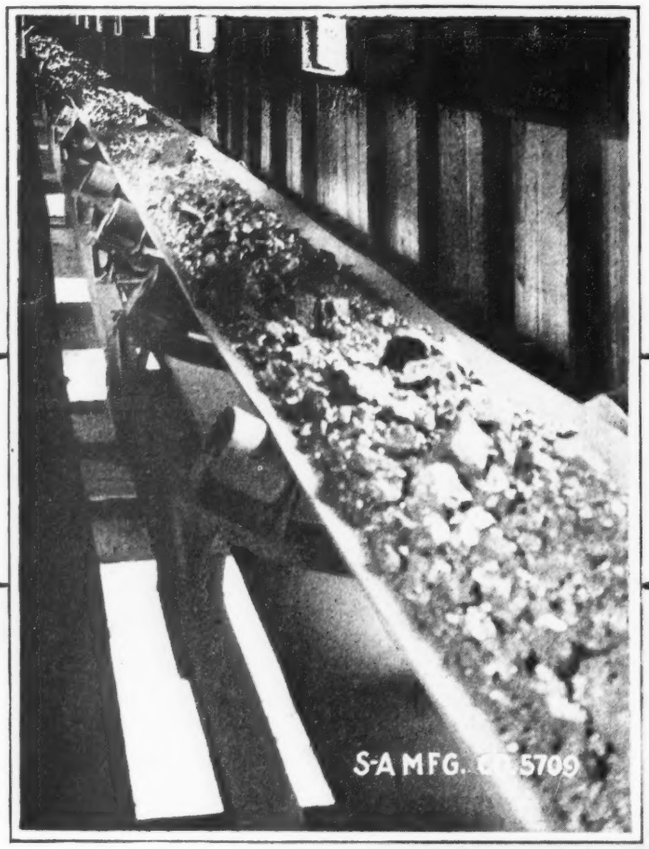
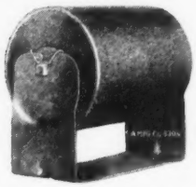
Biography of Robert George Hall





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It is largely as a result of the dependable service which S-A Unit Carriers have everywhere rendered that belt conveyors have rapidly displaced all other modes of handling ore and other bulk materials. The mechanical simplicity of the belt conveyor coupled with staunch all-steel construction of S-A Unit Carriers have made this mode of transporting materials unequalled for both efficiency and economy of upkeep.

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The adjustability of the unit design permits of adapting S-A carriers to practically any arrangement. They can be changed about and used again and again as requirements may change.

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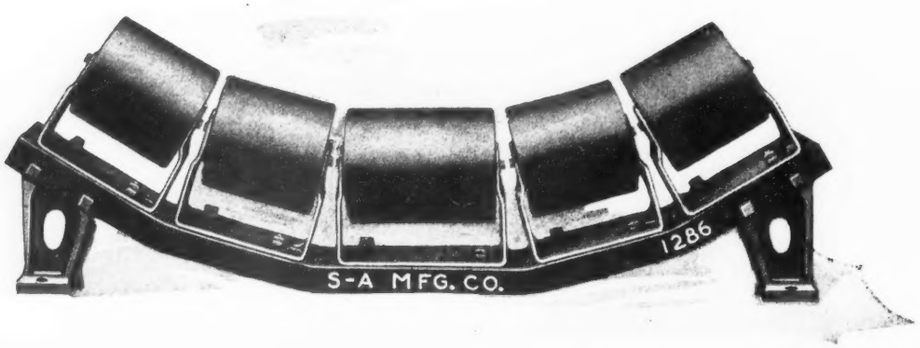
Aurora, Illinois



ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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New Status of United Comstock

THE SALE of the United Comstock Mines Co. to the Gold Fields American Development Co., Ltd., concludes an interesting series of events in the history of that enterprise. These are as follows: In response to the persistent reiteration of stories that large tonnages of low-grade ore still remained in the Gold Hill area of the Comstock, two enterprising individuals, Humphreys and Wise, sunk a shaft and conducted a partial exploration of the historic ground. A considerable quantity of low-grade ore was found between the surface and a depth of 600 ft. Efforts to interest capital were made, and Bulkeley Wells finally took the property over on behalf of the Metals Exploration Co. and organized a subsidiary company. Thereupon began an active campaign of mine development and mill construction. A lavish expenditure of capital resulted, and the wheels of the enterprise were started with due ceremony. Mill and mine difficulties speedily developed and after about six months' operation changes in management were made in an endeavor to pull the enterprise out of "the red." These culminated some time later in the resignation of Wells from the Metals Exploration Co. The tightening of the loose threads of the enterprise was effected by R. H. Channing, Jr., and his assistants and finally moderate operating profits were made. These are insufficient to retrieve the capital input, and the enterprise dropped into the salvage status. The increase in the price of silver helped not a little to increase the operating profit. The gamble of the situation lay in the possible discovery of new orebodies. Some exploration was undertaken, but it was obvious to many that the situation involved sending "good money after bad," for the Gold Hill area had been explored extensively both at the surface and below ground.

In the meantime the Comstock Merger was formed, including what is known as the "Middle Group." Options were taken by the Gold Fields American Development Co., Ltd., and exploration began. We understand that a good tonnage of ore has been developed. At least the options were exercised. Considerations of plant problems for this group brought up the possibilities of using the plant of the United Comstock. Negotiations were opened, the objective being the amalgamation of both companies. These resulted inconclusively, and finally the sale of the United Comstock to the new company was announced. This, in our opinion, is a sensible outcome, for it will no doubt materially reduce the capital input of the Comstock Merger and will enable that property to begin production much sooner than would be otherwise possible. Apparently mining in the Middle and Gold Hill Groups will be done upon a different financial status and should therefore be upon a sounder basis. The capital input of the Comstock Merger has been placed principally in exploration and development. The additional capital input goes to plant facilities acquired at a relatively large discount on the basis of original cost of installation. The advantages are obvious.

Whether the Metals Exploration Co. acted wisely or not is not known to us, as we have no precise knowledge of the terms of the sale. This is, however, of importance only to the parties involved. We are glad to note the sounder financial position attained by this group of mines and we extend our well wishes for its future success.

Removing the Lid From Statistics

IT SHOULD BE a source of great satisfaction to the metal producing and consuming industries that the non-ferrous metal producers recently decided to permit the publication of their statistical compilations. It is especially gratifying to us, for we have always maintained that the release of these figures to the public would never result in harm to the industries gathering them, but would actually work to their advantage. As most of our readers know, these statistics have been collected for the producers by an organization devised particularly for the purpose—the American Bureau of Metal Statistics. Hitherto the compilations have been carefully restricted to private circulation among the contributors to the service. From now on, however, the figures will be given full publicity and may be used by the business and technical press of the country. That they will be a valuable guide to the economic position of all the non-ferrous metal mining industries goes without saying.

It is a peculiar coincidence that since the publication of the statistics and their full release, the non-ferrous metal markets have become stronger than for many months. Although it would manifestly be unfair to contend that a connection exists between these two events, it is no more so than the oft repeated objections of some producers who claim that the publication of the tables is detrimental to satisfactory market prices.

An important if not the governing factor in influencing producers to permit the release of statistical information has been the attitude of the government, more especially the Department of Commerce, toward the use of statistics privately gathered and distributed by producers and consumers in all industries. The department has advocated—quite correctly, we think—full publicity for all the collective records of trade associations and has urged their wholesale release as one method for avoiding any legal entanglement with the government over the private collection of statistics. Many industries were quick to fall in line with this idea. In metal mining the progressive American Zinc Institute has been issuing monthly zinc statistics promptly and widely for several years without the slightest injury to any member; but the other branches of the non-ferrous metal industries have been slow to adopt the sound advice of the government. Only now have

they followed the lead of the Zinc Institute; but it is to their credit that at last they have allowed the light to penetrate their records. The government is to be commended for the rational view it has taken.

And now we shall have an opportunity to observe the effect of releasing the producers' figures. Will they prove damaging to them? We think not. It is well to remember that the statistics released all refer to past performances. The daily metal market is made more by momentary conditions and the prospects for the future than by something that has already taken place. Furthermore, statistics can be interpreted generally so widely that various conflicting inferences can be drawn from them. If the situation in any metal looks cheerful, prices will reflect that sentiment, and vice versa. It is up to the producer, when prices are low, to refrain from laying the blame upon the publication of a frank but perhaps unsatisfactory statistical picture; and to remedy the situation by the most effective means at his disposal—a control of production.

Regulated Exploitation of Natural Resources

ONE OF THE REMEDIES for the violent and wasteful exhaustion of the oil resources of the United States is a federally devised co-operation among the different surface owners of a given oil pool. This community exploitation suggestion follows the idea of the irrigation district or the drainage district, where a community which benefits by the irrigation or the drainage operation works under a common organization, each individual receiving benefits equably and contributing equably toward the undertaking. It is, in short, the idea of community exploitation rather than the law of right by capture, which has been rightfully pointed out as swiftly destructive and wasteful.

The Washington correspondent of *Coal Age* points out that this unbridled competition and exploitation is not only ruinous to the oil industry but to the coal industry as well. The thoughtless competition of well owners to get the oil before their neighbors get it leads to vast quantities being dumped on the market for any price it will bring (since much storage is impracticable), so that the price of fuel oil cuts under the price of coal and tends to put it out of the market. The coal industry is thoroughly upset, mines are closed down, miners are underpaid (in the run of the year's work); troubles arise, and discontent, not only of labor but of all other elements, as must be the case in anything which is not governed, but runs wild.

This brings up the question whether within the coal industry itself the community or co-operative plan of operating by districts, which Mr. W. L. Doherty has suggested for the oil industry, might not operate to advantage, and eliminate some of the loss and waste caused by cut-throat competition.

It is understood that Secretary Hoover has tended to consider such an idea favorably: while realizing that competition in the coal business, as in any other, is healthful and necessary, the question is whether competition between co-operatively organized districts might not be more beneficial to the coal industry and to the public than ungoverned and unregulated competition. The thought is modern and worth considering. If it is sound, it will apply to forest preservation, concerning which there has been too little regulation. As the result of the Forestry Conference in Washington Nov. 19 and 20, it is likely that the conservation and waste-avoiding problems for forest products will be put up to the Central Committee on Lumber Standards, organized two years ago by Secretary Hoover. The conference reported that:

> "Reducing needless drain will tend to lower the cost of raw material, will create additional sources of profit from material now wasted, and will lengthen the life of plant investments by prolonging the supply of raw material.
>
> "The task of reducing these losses is a joint responsibility of the industrial, commercial, agricultural, governmental, educational, and professional interests, and the public."

If oil, coal, and forests need organized effort for proper utilization, protection, and most efficient and economical ultimate exploitation, what is the situation with the metals? Undoubtedly they are in the same boat. Few people have visualized this problem for the metals; and no organization looking toward systematic co-operation has been suggested. The most pertinent suggestions have come from the reports of the U. S. Geological Survey; and also from the reports made by the Committee on Foreign and Domestic Mining Policy of the Mining and Metallurgical Society of America. Some further and more active organization and study is needed. We are face to face with the problem of rapid metal depletion, and there is a great wastage going on in many ways.

New York a Mining Camp

IN SUCH A GREAT MEDLEY as New York, individuality is subordinated, and separate groups are obscured. Yet if the call for any one group is made, it is astonishing what a number emerge from the multitudes. A rallying of the Abyssinians in New York would, we feel sure, bring out a crowd—we passed recently on the street the Second Abyssinian Church. So it is with the mining industry. If there be any left who imagine that New York is remote from the centers of mining interests, he might attend a meeting of the New York section of the American Institute and compare in numbers with meetings of the sections in Denver, St. Louis, or San Francisco. Engineers pass through New York. It was once said that if you lost any one you should station yourself on the pontoon bridge which leads from Stamboul to Galata in Constantinople, and sooner or later he must pass. Sooner or later your mining engineer passes through New York. But there are also many important mining enterprises close by. Recently an editor was on the 1,600-ft. level of a great zinc mine at three o'clock—at seven he was in New York. Many types of productive mines are within as easy reach—or at least not far away. It is an over-night trip—from supper till breakfast—to Ontario or to Quebec. Add to all this the fact that New York is the metal refinery and metal marketing center of the continent, and we see why it is the center of mining news and enterprise.

Jim Butler, of Tonopah, when he visited New York, and was asked his opinion of the town, observed, "I think she'll make a permanent camp." One of New York City's experts in a speech recently stated that plans were being made for a population of twenty million in 1975—in fifty years. This doesn't strike the present inhabitant of the town too agreeably, for it is already somewhat congested, but the miner may reflect what a metal market this means—how much steel and copper, silver and gold this teeming population of the city will progressively demand; and he may have a vision of old mines reopened, and contentment once more settling on the hills that had become deserted for lack of an adequate price for metal.

Growing American Zinc Industry

WHILE EUROPE IS LOSING in the production of zinc, as noted in our Nov. 15 issue, page 761, the United States is gaining. A bulletin from the Census Bureau of the Department of Commerce points out that zinc products of 1923 were valued at more than $94,000,000, compared with $37,000,000 in 1921—an increase of 151 per cent. The average number of wage earners in zinc smelting and refining establishments rose from 5,700 to 11,190; their wages from something more than $7,000,000 to nearly $17,000,000.

Doubtless one of the chief reasons for the growth of the zinc industry in the United States, compared with Europe, is that the United States has more abundant ore. For many years zinc production did not flourish in the United States, the metal either being largely wasted in the smelting of other metals or avoided and not mined. For many years zinc was principally known to many miners as a metal which the smelters penalized. During those periods Europe knew how to produce zinc cheaply, and commanded the industry, from abundant European sources and from imports from Australia. As these sources diminished and the price of zinc rose accordingly, the latent reserves, so long thus naturally resting in American mines, came to the surface. Especially responsive have been the Joplin and the Miami districts, in the middle Southwest.

Writing for a "Mining Publication"

"LET MR. BLANK talk to you if you want more business," begins a snappy ad. in a prominent newspaper. Then follows an account of the advertiser's capabilities:

"'My business is mining. What do you know about it?' Blank was asked several years ago.

"'Nothing,' he promptly replied. 'Writing is my business, and I do know that. Give me time to get the facts on mining and I'll guarantee that I can write better copy than you could write.'

"In a short time Blank's articles in a mining publication were being quoted as authoritative."

Well, there are mining publications, *and* mining publications. Some publish facts; others, fiction. One who is not versed in the technology of mining and metallurgy, even though unlimited time is at his disposal, does not know where to look for the essential facts; neither is he capable of making a mental or physical assay of the gold brick that usually glitters even more proudly than does the regular product of retort and smelting furnace.

The *Journal-Press* is accustomed to be quoted as authoritative, and this is due in no small measure to the fact that we are not influenced in favor of a contributor who can write "better copy." We have our own standards to maintain as to the appearance of what is published; but accuracy, brevity, and interest are the requirements that claim first consideration when a contribution is received. The preparation of copy for the composing room is a routine task in any editorial office; the problems of production cannot be shared between editor and contributor, although the latter can be helpful in avoiding trouble for all concerned by the exercise of preliminary care in the collection of data and in the preparation of the manuscript. The compilation of an article on any phase of mining and metallurgy is not a task that can usually be safely entrusted to a professional writer who is unversed in the technology of the specific subject. The test of authoritativeness is the professional status and experience of the author, not the ability to produce "better copy."

The "Pork-Knocker" and His Methods

IN BRITISH GUIANA, according to a handbook prepared for the Wembley exhibition, the major portion of the gold obtained from the alluvial washings has been won by the "tributor," or, as he is locally called, the "pork-knocker." The origin of this name is unknown, but it was first given to a large class of men who originally started work in the fields as laborers with a claim holder, and who, after the companies and syndicates ceased working, remained in the districts and continued to "fossick" on their own account on the claims abandoned by their employers.

Sometimes small bodies of men, five or six, or even ten in number, combine together in their work, and, cleaning up at the end of each day, divide the results equally. With the tributor established, provision shops became necessary where he could take his gold at the end of each day to sell, purchasing his necessary food and stores in return. The shops sprang up on all sides in the various districts, and the necessaries of life can now be easily obtained at fair prices in all the principal fields. These shops have been an important factor in the pursuit of the gold industry in the colony. The shop owners locate claims in the vicinty of their shops on which tributors are permitted to work on the understanding that they obtain their supplies from and sell their finds to the shop owner.

The tributor, after prospecting, begins work by digging a pit from 14 to 20 ft. square. All the overburden, where such occurs, is dug out until the "pay dirt" or gravel is reached. In this pit a "tom" or a "sluice" is then erected.

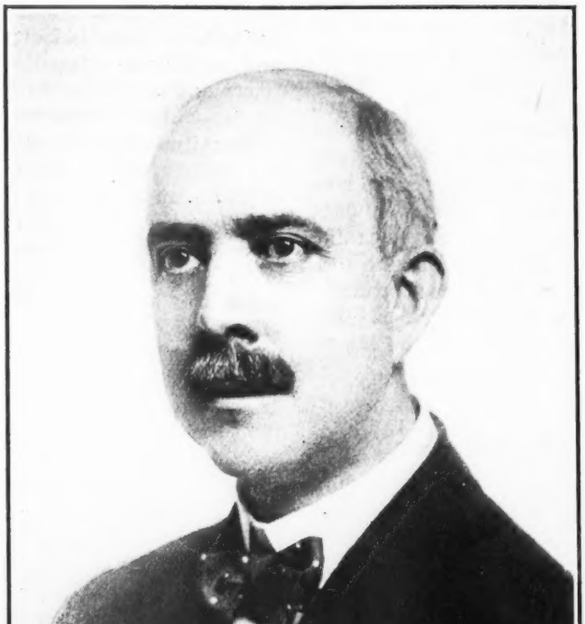
The "tom" is an open box about 8 ft. long, 3½ ft. wide, and 15 in. deep, with an open screen inclined at an angle of 45 deg. affixed at one end. This box is hung on pickets driven into the bottom of the pit. Into the "tom" is thrown the gravel dug out of the pit, and this is puddled against the screen with a constant stream of water brought in through the opposite end of the "tom." This liberates the gold, the fine particles of which pass through the screen and are caught in quicksilver in the riffles placed in a small box just below the end of the "tom." Any large nuggets remain against the screen and can be picked out by hand; the sand and dirt that is washed away runs into a tail ditch.

Sluicing is carried on in practically the same manner, but has the advantage of allowing a larger number of men to work at the pit, which is made about twice as large as that used for the "tom." The sluices are wooden boxes about 12 ft. long and 1 ft. wide and deep. They are placed end to end, and sometimes as many as six are used at one time. A strong stream of water is passed through the sluice into which the pay dirt is thrown. The rush of water carries the mass along the length of the sluice and so does the cleaning work, and saves puddling as in the "tom." The gold is caught in riffles placed along the whole length of the sluice. The sluice is not suitable for stiff ground, which is better worked with a "tom," but it has the advantage of enabling a larger area of ground to be worked with a comparatively smaller number of men.

Metallurgists of Note

Robert George Hall

PRELIMINARY EXPERIENCE of responsibility, and graduation from the school of hard knocks, prompts an appreciation of the benefits of specialized education that is seldom realized by those who pass, by ordinary methods, from school to university. Education by the former process is likely to be enhanced by inquisitiveness and intensive application, both the result of a maturing outlook on life. Thus it was with R. G. Hall, of British ancestry, who when eighteen arrived in the United States from Ireland, the land of his birth. Business experience at Pittsburgh for four years acted as a spur to ambition; and in 1893 he entered the Massachusetts Institute of Technology, where, by combining the chemical course with the mining courses, he was the first to map out a grouping of subjects that has since formed the schedule basis for prospective metallurgists. While there—to emphasize the dominant notes — he came under the fine character influence of Dr. Robert H. Richards and the precise scholarship of Dr. H. O. Hofman. Among his teachers was Dr. H. M. Howe, who lectured on the metallurgy of copper and iron. After being graduated, in 1897, Hall became assistant chemist to the Pueblo Smelting & Refining Co., at Pueblo, Colo. Between then and 1901 he rose to the position of chief chemist and chief assayer. Followed experience in the metallurgy of gold in the San Juan district and in the Cripple Creek field, during that interesting period marked by the displacement of chloridizing by cyaniding. Responsibilities included the management of the property of the American Gold Mining Co. at Ouray and others in Colorado. In 1905 he became assistant superintendent, and later general manager, for the United Zinc & Chemical Co., operating in the Kansas natural-gas belt and at Leadville, Colo., handling Western zinc ores by magnetic concentration, then a new process, at the Yak mill, in Leadville, and producing heavy chemicals and metallic zinc in Kansas. It was an interesting period in the metallurgy of zinc, marking the earlier attempts at a zinc smelter to handle high-iron ore in retorts. Practice in Belgium had been successful for several years, because of superior equipment; and it was not until hydraulic methods were adopted in the Mississippi Valley region for the manufacture of retorts that success was achieved in the United States in the treatment of zinc ores containing as much as 15 per cent iron. In this country the U. S. Zinc Co. put in the first of these new retort machines; Hall, for his company, the second. Joplin ores with 60 per cent zinc and 1 per cent iron; Western ores containing as little as 30 per cent zinc and as much as 25 per cent iron, and Leadville carbonate ores with less than 20 per cent zinc—the treatment problems of all were solved there. During this period Hall built a zinc smelter at Springfield, Ill., also for the United Zinc & Chemical Co. From 1913 on, Hall deflected his attention to research and investigation on the treatment of complex Western ores and the production of electrolytic zinc. In 1918 he was appointed to one of the premier positions in the profession, that of resident manager for the Burma Corporation, Ltd., being engaged to apply his skill and experience in an attempt to improve the treatment of the complex ores of the famous Bawdwin mine. A successful process, developed by Hall and his staff, is now in operation. Briefly, it consists of the concentration of the low-grade ores to produce lead-silver concentrate and zinc concentrate, smelting the former with high-grade ore for the production of base bullion. Success, depending on an ability to produce a lead slag of high zinc content, was achieved. The plans included a method, not yet in operation, for the recovery of zinc from the slag. His work in Burma being completed, Hall returned to the United States in 1921. He is now in private practice as a consulting metallurgist.



ROBERT GEORGE HALL

Those who have failed in an attempt to find an account of Hall's achievements in the usual directories will appreciate the fact that he is unassuming, and persistent in his efforts to deflect attention from himself. Suffice to say, however, that in addition to being a distinguished metallurgist, the subject of this brief biography is one whose personal attributes reflect credit and honor to the profession of mining engineering.

Tunneling Operations at Big Creek, Calif.*

An Important Project Now Being Pushed to Completion in Sierra Nevadas

By E. D. Gardner
Mining Engineer, Southwest Experiment Station, Tucson, Ariz.

E. D. Gardner

IN DEVELOPING hydro-electric power in the Big Creek project on the San Joaquin River, in the Sierra Nevada Mountains, the Southern California Edison Co. is conducting large mining operations, a description of which should be of interest to the mining industry. This company is one of the largest consumers of mining explosives and drill steel in the country. As an example of the magnitude of its underground operations, it may be stated that the monthly consumption of gelatin explosives is 120 tons. Up to August, 1923, about 200 tons of explosives were used every thirty days, and more than 2,600 tons were used in 1923. The supply of drill steel hauled in for use during the winter months of 1923-24 at the upper camps amounted to over 300 tons.

Six miles of 21x21-ft. tunnel were completed in August, 1923, and a 12½-mile 15x15-ft. tunnel is now being driven from six headings. This work is expected to be completed in March, 1925. Nineteen miles of the total of 86 miles of tunnels for which plans have been made have been completed.

The waters of the San Joaquin are to be harnessed at their source, which is at an elevation of about 7,200 ft.; they will be used six times for generating power, and will then be discharged into the reservoir of the Kerckhoff plant of the San Joaquin Light & Power Corporation at an elevation of about 1,000 ft.

The water is impounded by dams in the upper mountain parks, then runs through tunnels to the penstocks of the power plants. The tailrace of one power plant discharges into the stream bed just above the diversion dam for the next plant below. The dams also divert water coming into the streams between plants. No surface ditches or conduits are used, and the water is taken from the diversion dams directly underground into the tunnels leading to the penstocks.

The two original power plants were installed in 1912 and 1913. The third plant was completed in 1921, and the fourth in 1923. At present, 259,000 hp. is generated. Within the next ten or twelve years a total of 1,400,000 hp. is expected to be developed. Power plants Nos. 1, 2, 8, and 3 are now operating. With the completion of the 12½-mile tunnel now being driven from Florence Lake, an additional 100,000 hp. will be available in 1925.

*Published by permission of the Director of the Bureau of Mines.

As there is an ever-increasing demand for power in southern California, the early bringing in of new sources is greatly desired, and the speed factor is considered along with the cost in the doing of this work. By the time the 12½-mile tunnel is finished, it is stated that $100,000,000 will have been expended; the ultimate total cost, including distribution systems, will be close to half a billion dollars, or more than the cost of the Panama Canal.

The energy from these power houses is conveyed to Los Angeles and vicinity over transmission lines 240 miles long, operating at 220,000 volts. These lines were the first to operate at this high voltage. One-inch cables, which contain 54 aluminum strands and a 7-strand steel core, are used.

Before the tunnel work could be started, very heavy expenditures were necessary in building roads and camps. A railroad more than 50 miles long and of all-mountain construction, was also built to facilitate the work. The upper camps are at an elevation of 7,000 ft. and in a region of heavy snowfall. All heavy supplies, which are hauled by fleets of motor trucks, must be taken to the upper camps during the summer months and stored for winter use. After bad storms in the winter, dog sleds are used to take in mail until the roads are again open. Radio is used for communicating between the various camps.

E. R. Davis is manager of construction for the Southern California Edison Co.; A. F. Blight is assistant manager of construction, and D. H. Redinger is resident engineer in charge of construction, on the Big Creek development.

A very able summary of the progress made and a description of the project is given by D. H. Redinger in the *Compressed Air Magazine*, beginning in the December, 1923, number.

Tunnels Driven Through Granite

The area of the power development is in the main granite batholith of the Sierra Nevada mountains. The granite through which the tunnels are driven is mainly solid and is hard to drill and break. With the exception of short stretches through fractured or disintegrated rock, which has to be timbered and then concreted, the walls of the tunnel stand well and require no lining. When in use, the tunnels are all under pressure, but no difficulty has been encountered by the rock not holding water or by spalling of the walls.

The organization of the tunnel forces reflects great credit to the engineers in charge. All operations dovetail into each other, and there is little lost motion or time wasted by one set of workmen awaiting the completion of an operation on which other workmen are engaged. Operations are continuous; three eight-hour shifts are worked, seven days a week. The shifts change at 8 a.m., 4 p.m., and midnight. The men are taken to the surface to the boarding houses for lunch on each shift on the short headings. On the long head-

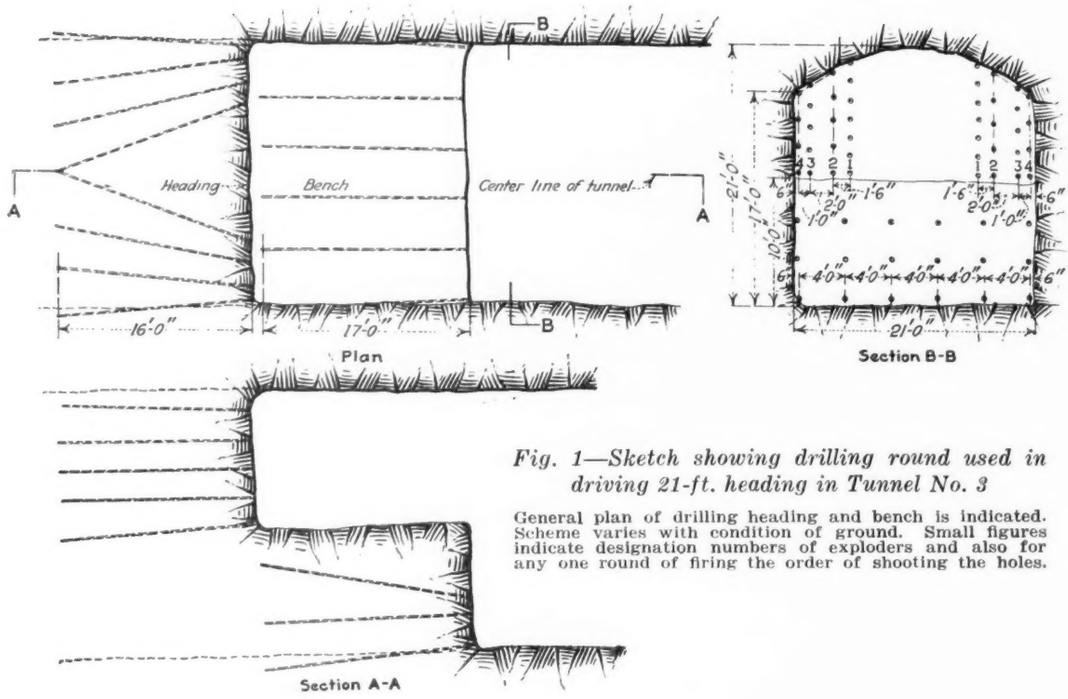


Fig. 1—Sketch showing drilling round used in driving 21-ft. heading in Tunnel No. 3

General plan of drilling heading and bench is indicated. Scheme varies with condition of ground. Small figures indicate designation numbers of exploders and also for any one round of firing the order of shooting the holes.

ings specially equipped lunch trains are used. The cars on this train are set up with tables and benches and the food is kept warm in thermos containers. By the use of these lunch trains it is necessary to move the men back only a short distance from the heading at lunch time, and the men are served with a hot meal the same as if in the mess hall at the portal. Motor trains are used for hauling the shifts in and out of the tunnels. The boarding-house employees also work three shifts.

The bench-and-heading method is used for driving the main tunnels. The headings are driven full width of the tunnels at the top and are about seven feet high.

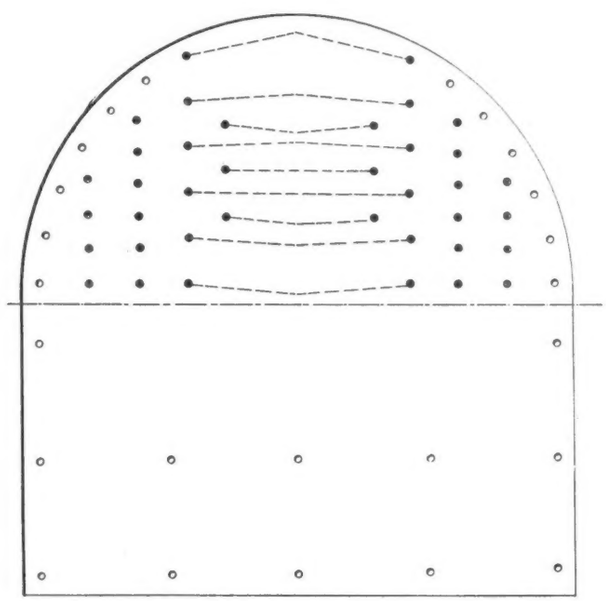


Fig. 2—Sketch showing drilling round used in driving 15-ft. heading, Tunnel No. 6

The shoveling is done mechanically by means of compressed-air-operated shovels. The broken rock is hauled out by heavy electric locomotives which are of a combined storage-battery and trolley type.

Drilling Notably Efficient

The No. 3 tunnel recently completed is 21 ft. in diameter, and the 12½-mile tunnel (No. 6) is now being driven and is 15 ft. in diameter. This latter tunnel is being driven from six faces through adits that are driven into the tunnel line from certain advantageous points.

The heading is kept a round ahead of the bench. After each heading round, the face is mucked back by the drill crew and four extra-heavy hammer drills are set up on two columns. A heading round in No. 6 tunnel is drilled in an average of five and one-fourth

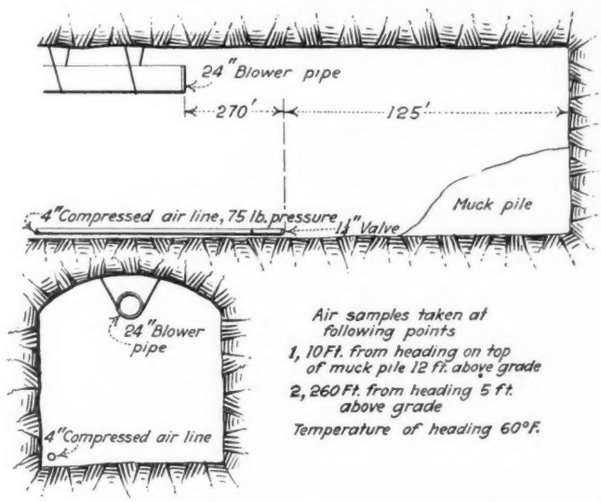

24" Blower pipe
270'
125'
4" Compressed air line, 75 lb. pressure
1" Valve
Muck pile
24" Blower pipe
4" Compressed air line
Air samples taken at following points
1, 10 Ft. from heading on top of muck pile 12 ft. above grade
2, 260 Ft. from heading 5 ft. above grade
Temperature of heading 60°F.

Fig. 3—Arrangement for ventilating face after a blast

After firing, fans are run exhaust for about one hour, then as blowers. The fresh air supply is also augmented by exhaust from drills and shovel.

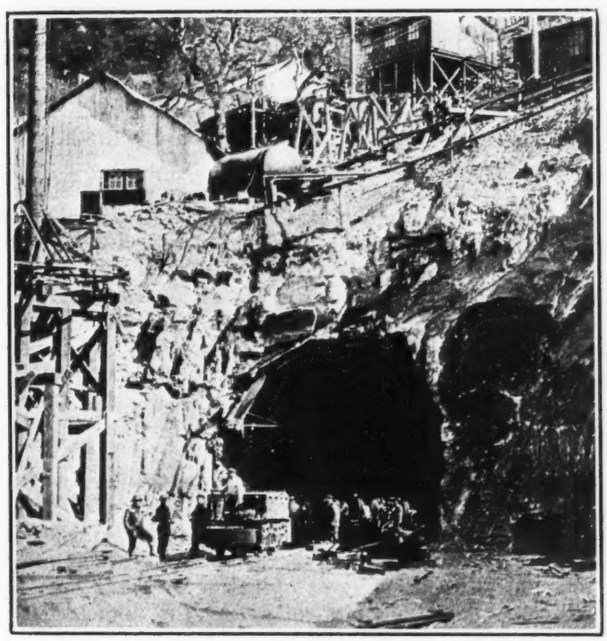
hours after the air is turned on. There is no "taking five" by any of the drill runners, as each man has to finish his allotment of holes at near the same time. Machines and air and water hose are all inspected daily and time is seldom lost by machines breaking or having to be changed.

The drilling crew at a face consists of four machine runners, four helpers, two steel nippers, and one drill boss.

In the larger-diameter tunnels, one heading round was drilled for each bench round, but in the smaller bores it was found to be advantageous to shoot two heading rounds, one 10 ft. and the other 8 ft. deep, to each bench round, as it was not possible to get sufficient angle between the cut holes in the longer heading round to break bottom. Figs. 1 and 2, on the preceding page, show rounds in the 21-ft. and 15-ft. tunnels, respectively.

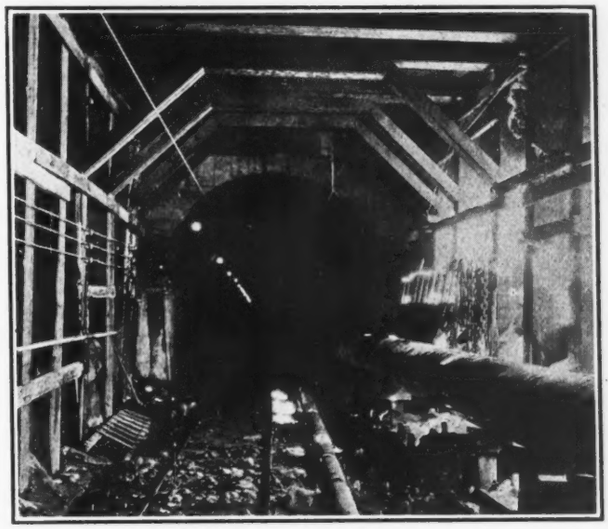
Thirty-six to forty-two holes are generally drilled in each heading round. In extra hard-breaking ground, six short "V" cuts, called "relievers," are drilled between the regular "V" cuts. The heading rounds in the 15-ft. tunnel require as many holes to break as did the heading rounds in the 21-ft. tunnel. The cuts of the first heading round are shot first and the bootlegs reloaded. The bench round, consisting of fifteen holes, is drilled by four or five machines set on short arms on a crossbar. In the 21-ft. tunnel an extra hole was drilled in each row, making eighteen in all required to break the bench.

Drill steel made of 1¼-in. hollow round with ⅜-in. core is used, and is of the best quality. The starter bits are 2¾ in. in gage, and there is ¼-in. difference in each change of 2 ft. in length. The finishing steel is 19 ft. long and has a 1⅝-in. gage. As a 19-ft. drill steel weighs about 75 lb. and takes five minutes to change, the need for nippers is evident. The rock is so hard that a piece of steel can seldom be used a second time without resharpening. Between seven and eight tons of drill steel are handled in drilling a round. The steel consumption is from 15 to 20 lb. per foot of tunnel.



Outlet portal of No. 3 tunnel

Eight-ton Westinghouse combination trolley and storage-battery locomotive just coming out.



Outlet of Florence Lake tunnel

Concrete lining, blower pipe, air line, and railroad track are shown. Tunnel is lined for about 900 ft. at outlet on account of soft ground.

One tunnel was driven by use of a small pioneer tunnel, which was enlarged to full size by drilling and blasting rings of holes. Though this method had many advantages, it was decided by the company that faster progress could be made by using the headings and a bench. Occasionally, at the present time, in starting an adit or heading where no power shovels are available, the pioneer tunnel is run and then later enlarged when the mechanical loaders can be obtained.

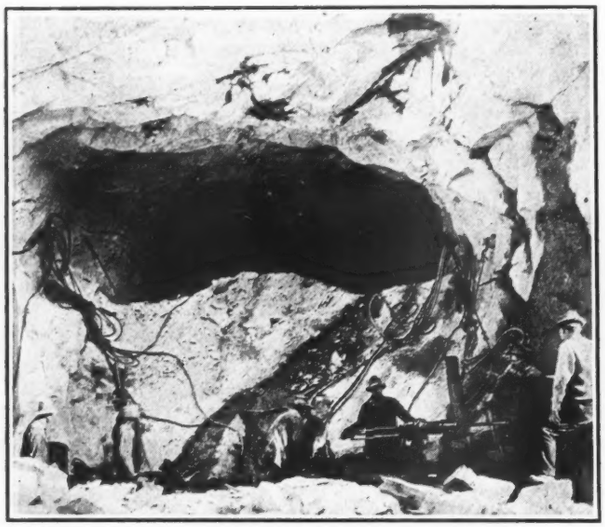
Blasting with 60 and 40 Per Cent Gelatin Dynamite

Blasting is done with 60 per cent and 40 per cent strength l.-f. gelatin dynamite in 1¼x8-in. cartridges.

The main supply of explosives is stored in large magazines at a safe distance from the camps. Magazines to hold the daily requirements of each heading are situated near the portals.

Electric detonators in eight delays are used in all blasting. Primers are made up on the surface by the

Shovel ready to enter adit, Tunnel No. 3



Drilling bench in No. 3 tunnel

Drilling of heading has been completed. The columns are still in place.

powder men. The wire legs of the detonators are coiled around the primer cartridges until ready to load. Special cartridges 10½ in. long are used for holding the No. 8 delays. Sixty per cent gelatin dynamite is used for all primers.

The blasting is done by the regular drill crews. Sixty per cent l.-f. gelatin is ordinarily used in the cut holes and relievers, and 40 per cent l.-f. gelatin in the remainder of the holes. In extra hard-breaking ground, 60 per cent strength is used in most of the holes of bench rounds. Primers are placed the second stick from the bottom in the drill holes. The detonators are wired in parallel and their legs are connected to bus wires stretched across the face. The two legs of the detonators are of different colors, which arrangement assists in wiring the round. The bus wires are connected to the main blasting lead line with about 200 ft. of firing line. The electrician advances the wires of the blasting circuit and brings up the firing line to the face of each round. The blasting circuit of 440 volts is carried on the opposite side of the tunnel from all other wires and pipes. The circuit is completed by a safety switch at the surface. This switch is always kept locked, and is so constructed that it cannot be locked unless the switch is open.

Each heading round in No. 6 tunnel is blasted with between 450 and 550 lb. of explosive, and a bench round with 400 lb. Seventy-five to eighty pounds of explosive is used per foot of 15-ft. tunnel, and 115 to 120 lb. were used per foot of the 21-ft. tunnel.

The second heading and the bench rounds are blasted together. Flying material from the cut holes of the heading is partly smothered by the bench round. At this time clay stemming is used in loading all the holes.

Mucking and Hauling Entirely Mechanical

The broken material is handled mechanically, mostly with compressed air-operated Marion No. 20 shovels with ⅝-cu.yd. dippers. These shovels have been cut down in the company shops to fit the 15-ft. tunnels. Ten-cubic-yard cars were used in the larger tunnels, but 3½-cu.yd. cars are in use in the No. 6 tunnel, as the larger cars are too big to get by the shovels.

A single track of 36-in. gage is used, with turnouts at suitable places and a double track at the face. The shovel runs on the right-hand track at the face. Three locomotives are used for each heading. While one train is out, a locomotive is used for pushing up the empties on one track and another locomotive for pulling away the loaded cars from the shovel.

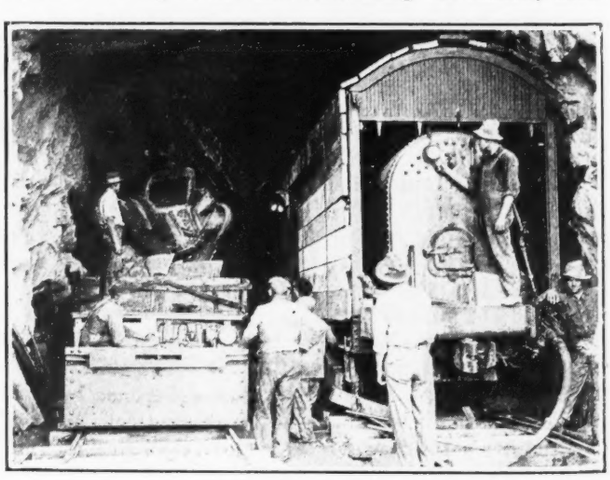
Six cars are handled in each train. The empties are pushed up on the shovel track and transferred to the loading track as needed by means of a boom built in the end of the shovel. Bridle chains are hooked onto the frame of the car on both ends, the car is raised by a tugger hoist, swung over the loading track by hand, and then lowered. It is then coupled on the loading train, pushed to the business end of the shovel, loaded, and pulled back to make way for the next car. Individual cars are taken from the empty track, loaded, and pulled back in from four to five minutes. The shovel operates on an average between eight and ten hours a day. About 150 cu.yd. of material, in place, is broken in a 16-ft. round.

The train crews consist of two men each. Four trackmen on each shift maintain the tracks in repair and lay extension tracks.

The daily cycle of drilling operations in the 15-ft. tunnels is as follows:

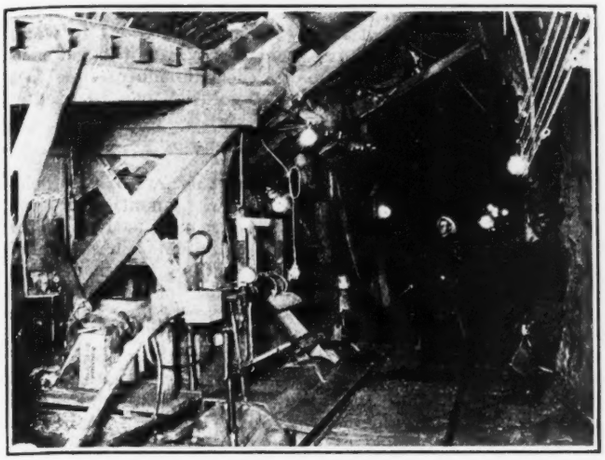
1. The first heading round is drilled and shot when finished.
2. The second heading round drilled.
3. The bench round drilled and blasted with the second heading round.

While the first heading round is being drilled, the shovel cleans up as much of the previous round as possible. After shooting, the first heading round is cleaned up along with what is left of the previous day's materials, while the second heading round is being drilled. If the second heading round is not entirely removed by the time the drillers are ready to drill the bench round, the miners, with the assistance of the shovelers, muck back before setting up. During the five hours the bench round is being drilled, any repairs to the shovel that may be needed are made at the face. The shovel is moved back about 500 ft. before each blast. The track men and muckers clean up the tracks after each blast. An extra drill crew is taken into a heading whenever needed to complete the cycle. Where lining is necessary, an extra crew of thirty or forty men is used in making forms and concreting the tunnel, after



Compressed-air-operated shovel working in heading

This shovel is not equipped with boom for transferring cars from empty to loading track.



Concrete plant in 15x15 ft. Florence Lake tunnel

Webb concrete gun in center of bottom of photograph alongside track.

the heading is sufficiently advanced as not to interfere.

Bad sections of ground are timbered as broken, which throws the cycle out of gear and cuts down the progress.

Rounds are blasted when ready and not at the end of shifts. The men go to work on their own time, and thus no time is lost by changing shifts. The drill runners do not even shut off the air while changing.

Ventilation System Effective

The tunnels are ventilated through a 24-in. wood-stave pipe which is suspended from the roof by brackets. A water spray is used in the intake of the stave pipe to humidify the air and thus prevent drying out of the wood. Fig. 3 shows the arrangement for ventilating the face after a blast. After blasting, the fans are run in exhaust for about one hour, then as blowers. The fresh air supply is also augmented by the exhausts from the drills and shovel. Just before blasting, the compressed air is turned on at the face to help clear out the fumes. The average time lost after each blast is about forty-five minutes.

Seven and eight-tenths cubic yards of material in place are broken to each linear foot of 15-ft. standard cross-section tunnel, but as there is about a 20 per cent overbreak at many of the headings the total material removed averages 9.4 cu.yd. per foot of tunnel.

The average speed of advance in six headings of No. 6 tunnel in August, 1923, was 12 ft. per day per heading. In ordinary ground a 17 to 19-ft. round is blasted daily.

The record progress for 1923 was 476 ft. of 21-ft. tunnel in one month, and 125 ft. of 15-ft. tunnel in one week. During February, March, and April, 1924, the average for each of the six headings was 15½ ft. During April a new weekly record of 152 ft. and a new monthly record of 578 ft., or 19½ ft. per day of a given heading, were made.

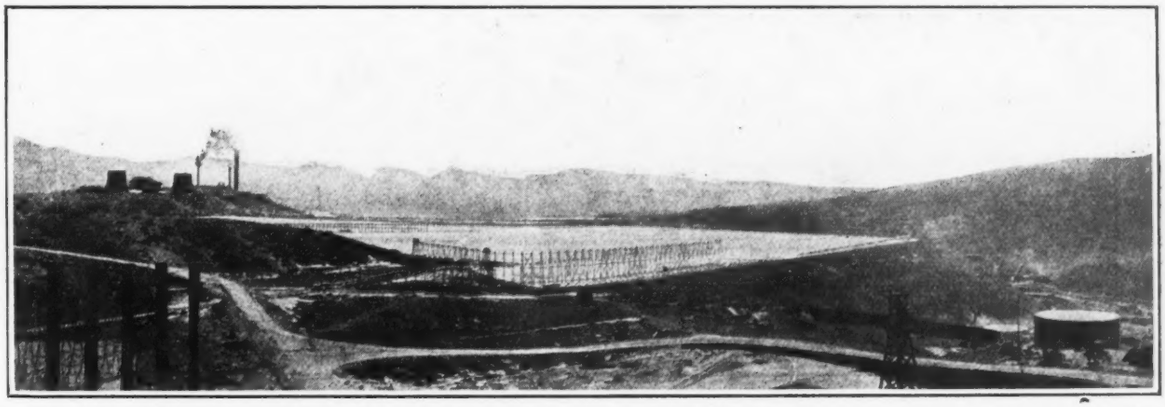
In all, 102 men are employed regularly in each heading on three shifts. Two timber men work only on day shifts, putting up ventilation pipes and doing other work. Five thousand men are employed in the construction work on the whole Big Creek project.

The total cost of excavating the material in No. 3 tunnels was about $12 per cubic yard. The total cost of the large tunnels averages slightly over a million dollars per mile. Much of their cost is due to heavy road construction and other work necessary before the tunnels can be driven.

Powder magazine on Florence Lake division

This is a double magazine, having inside dimensions of 18x70x10 ft. in clear, with no center posts. It is lagged inside and outside with 2-in. planks and covered on outside with corrugated iron. When exposed to the open, the walls are doubled and have a 2-ft. space between entirely filled with earth. When roof is exposed to open, it also is doubled with a 12-in. earth-filled space between. Magazine has a 2-in. plank floor with a half-inch space between planks to insure ventilation through floor. These planks rest on 12-in. joists set on 8 in. sills. Roof is built with 1 to 2 pitch, and covered with corrugated iron. Three 6x8-in. open box ventilators extend 8 ft. above the ridge.

Tailings Pond of the Miami Copper Co., Miami, Arizona



The space allotted to the tailings has been almost filled. Wood chips from the mill are spread over the sides of the dump to keep the wind from carrying the sand into the town of Miami, near by. The International Smelter may be seen on the left

An Old Plan to Recover Gold "In Place"

By Kirby Thomas
Mining Engineer, New York City

THE recent successful and unsuccessful attempts to recover copper by leaching "in place" in some of the western mines suggests a public record which was brought to my attention some time ago in another connection. In 1895 application for letters patent was made at Washington, D. C. by the late Herman Frasch, covering the recovery of gold and other metals with mining. The patent issued in 1896 sets forth:

"This invention relates more particularly to the recovery of gold from placer deposits which either contain gold in too small quantity for working by the methods heretofore known or used, or which from lack of water or peculiarity of location are not workable, at least profitably, by said prior methods. It may, however, be applied to the recovery of gold from other porous or permeable deposits and to the recovery from such deposits of analogous metal (silver or platinum, for example)."

The plan is further elaborated as follows:

"The reagent employed may be any known or suitable substance or combination of substances for forming soluble compounds with gold or like metal, such as chlorine and bromine for gold, the alkaline hyposulphites for silver, and potassium cyanide for gold or silver, or both. Chlorine may be advantageously used for platinum. This is often present with gold and can be mined with it by means of chlorine. These are given as illustrations. Other reagents may be used. In using a combination of substances they may be used in admixture or in succession. An example of the successive use of substances would be the formation of silver chloride by the introduction of chlorine and the making of this silver chloride soluble in water by means of sodium hyposulphite."

If the deposits are flooded with water, it is proposed to displace the water by a solution of a suitable higher specific gravity—"a convenient substance being common salt." Concerning the solvent applicable to this method, the letters patent for the invention make this interesting suggestion:

"Assuming that gold is to be recovered, the reagent may be chlorine. This can be conveniently prepared in solution by dissolving chloride of lime (bleaching-powder) in water and adding enough sulphuric acid to liberate the chlorine. The use of about four pounds of the chloride of lime to a ton of water is recommended. The solution can be used at once, or be first allowed to settle."

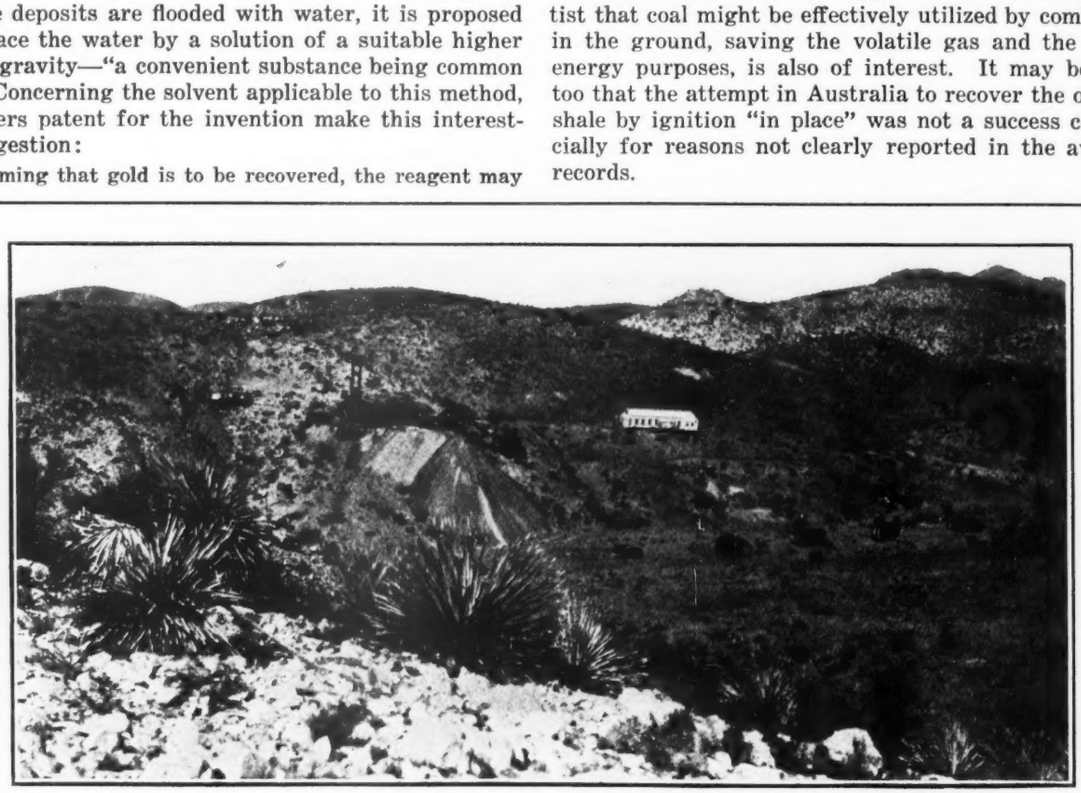
It is further suggested:

"The solution may remain in contact with the gold-carrying deposits for hours, days, weeks, months, or even years. Weak solutions may therefore be used, and the extraction can be continued until practical exhaustion of the gold. Any depth can be worked. As placer deposits do not ordinarily contain sulphides, nor other substances on which the chlorine would waste itself, loss from this cause would usually not have to be taken into account. In some cases where organic matter exists, a solution of cyanide of potassium can be used advantageously. Solutions of two-tenths of 1 per cent (or even one-tenth) will answer. In using chlorine for gold, if there be silver in the deposit, the chloride of silver formed thereby could be recovered by means of hyposulphite solution. If there be platinum, it would be recovered with the gold by the chlorine."

The patent claims are broad and varied and were apparently taken very seriously by the inventor at the time. They emphasize the possibility of recovering the "gold, platinum and silver" content of the deposits. Several diagrams show the physical application of the method to various types of placer deposits.

The patentee, Herman Frasch, invented, developed and applied the method of sulphur mining by means of melting with superheated water, now in use in the important "dome" sulphur deposits of the Gulf Coast region. His experiences and standing give interest to his metallurgical expectations, especially at this time when the long deferred plan to recover copper "in place" is being commercially utilized.

In this connection, the suggestion of a British scientist that coal might be effectively utilized by combustion in the ground, saving the volatile gas and the oil for energy purposes, is also of interest. It may be noted too that the attempt in Australia to recover the oil from shale by ignition "in place" was not a success commercially for reasons not clearly reported in the available records.



Surface plant of the New Dominion Copper Co. near Globe, Ariz. The ground is being prospected through a vertical shaft, 850 ft. deep

The Law of Mines and the Freedom of the Miner

By T. A. Rickard

AT FIRST, in the dawn of civilization, all mines belonged to the ruler of the land. The natural treasures of gold and silver, more especially, were the property of the king, who exploited them with the labor of criminals and captives. The conqueror forced the subjugated people to work in the mines of their native land. Mining became associated with the most cruel phase of oppression, incompatible with the development of technique. So long as the laborers were slaves and the overseers were slave drivers, the winning of the metals continued to be merely an unintelligent grubbing in the ground. Slavery starved ambition and initiative and stifled invention.

T. A. Rickard

The Carthaginians compelled the natives of Iberia, now Spain, to work in their mines, and, in turn, the Spaniards impressed the people of Mexico and Peru as workers in the mines of the conquered countries. In ancient days it was the custom to enslave prisoners of war, but it was deemed proper, among the Greeks, for example, to reserve the best of them for occupations less debasing than forced labor underground. That was the worst that could befall a man; it was even more dreadful than being sent to the galleys. Tacitus says of the Gotini, a German tribe, that "to complete their degradation, they actually work in the iron mines." Nor is this view surprising, having regard to the conditions under which underground operations were conducted: in small holes, damp and dark, foul for lack of ventilation, lighted by an ill-smelling little lamp.

Theophrastus, writing in 300 B.C., tells us how they mined on the island of Samos in his day: "Those who dig in the mines cannot stand upright at their work, but are obliged to lie down either on their backs or on one side; for the vein of the earth they dig runs lengthwise, and is only of the depth of two feet, though considerably more in breadth." The slaves at Laurion worked in excavations from two to three feet in width and height. Pliny describes how the fragments of ore were carried out of the mine "on the shoulders of the workers, night and day, each man passing them on to his neighbor in the dark, so that only those at the outlet ever see the light."

Agatharchides, as quoted by Diodorus, in his description of the Egyptian gold mines in 170 B.C., speaks feelingly of the fate of the slaves. He says: "Of those condemned to this disastrous life, such as excel in strength of body, pound the shining rock with iron hammers, applying not skill but sheer force to the work; these men, on account of the windings of the passages, live in darkness, and carry lamps attached to their foreheads. . . . As these workers can take no care of their bodies and have not even a garment to hide their nakedness, there is no one who seeing these luckless people would not pity them because of the excess of their misery, for there is no forgiveness or relaxation at all for the sick, or the maimed, or the old, or for woman's weakness, but all with blows are compelled to stick to their labor until worn out they die in their servitude. Thus the poor wretches ever account the future more dreadful than the present because of the excess of their punishment and look to death as more desirable than life." It is no wonder that Galgacus, the British chief, besought his soldiers to fight fiercely against the Romans under Agricola by warning them of their fate if they failed; they would become subject, if conquered by the Romans, he said, "to tribute and mines and all the other penalties of slavery."

The employment of slaves in mines survived to modern days. As late as 1719 a proprietor of lead mines in Missouri, named Renault, on his way to France, stopped at the island of Santo Domingo to purchase 500 slaves for employment in his mines. On Oct. 30, 1777, the Congress of the United States directed the Board of War to write to the government of the State of New York, recommending it forthwith to start work on the lead mines of that state, and promising, in case laborers were scarce, to supply prisoners of war for the purpose. Convicts were employed in the coal mines of Alabama and Kentucky less than forty years ago. Indentured Chinese labor was brought to the gold mines of the Transvaal in recent years, but even this humane practice aroused resentment in England, because the idea of any kind of forced labor underground is repugnant to men of liberal thought. The work of mining is arduous and hazardous; it calls for strength and intelligence, a combination of qualities usually to be found only among free men. During the dark ages in which the miner was shackled the technique of mining languished; when he won his freedom, the art of mining was born.

To the ancients in general a mine was treasure-trove, a place of metallic riches that needed but to be gathered by the finder or by him who dispossessed the finder. It is probable that the idea of an ore deposit as a natural treasure was reinforced when the use of metallic currency was introduced, because the privilege of coining money has rested with the ruler of the land from time immemorial. This regalian right pertained more particularly to deposits of gold and silver, which were regarded as peculiarly the perquisite of the king. Thus the Pharaohs exploited the gold mines of Nubia for themselves, Philip of Macedon worked the gold mines of Thrace on his own account, and the Roman emperors filled their private coffers with the treasure that came from the diggings of Dacia and Dalmatia. The Greek democracies adopted the idea of state ownership; Athens exploited the silver mines of Laurion for the citizens as a whole; the people of the island of Siphnos divided the wealth

gained from their mines among themselves, annually; the tin and silver that the Phœnicians obtained in Iberia were deposited in the national treasury at Carthage.

In the early days of the Roman republic the proprietor of the soil was the owner of all that lay beneath, but this custom expressed an ignorance of the character of mineral land rather than a reasoned policy. When the Roman dominion spread across Europe the mines in conquered territory became part of the public domain, the *ager publicus*, to be exploited by the state, either directly or by means of lessees, who paid a tribute, usually a tithe of the product. Such taxes were farmed by publicans. Even in Italy the mines on private lands were treated as sources of public revenue, but the owners were accorded the right to exploit the mineral deposits. If ore was found on land that did not belong to the finder, he paid a tithe to the owner as well as to the state. However, it may be said safely that there was comparatively little mining in Italy in republican times, for the industry, according to Pliny, was distinctly discouraged by the Senate.

Early Leasing Not a Success

The Romans, like their predecessors, operated the mines with slave labor; and in the main the work was done inefficiently. Then they tried a system of leasing, the lessee, of course, employing slaves, but supervising the operations himself. This leasing system proved disappointing, we are told, because the lessees extracted only the rich ore and neglected to safeguard the workings, in which respects they were only too sadly like the lessees of mines today. The stopes, it is recorded, were allowed to collapse and the levels were choked with waste rock, until economical work became impracticable. Thereupon the state again tried its hand; the workings were cleared, and the stopes rendered safe by means of rock-walls; substantial improvements likewise were made on the surface; but even then the results were disappointing, for the Romans were poor miners and depended upon others for the skill needed to render profitable their mining and metallurgical enterprises. Moreover, their mines were on the frontiers of the empire, and therefore exposed to attack by the barbarians, so that when the Roman dominion began to collapse the mining industry was one of the first to suffer.

Gold and Silver Property of the State at First

The Roman idea of regalian right, or "mines royal," survived long after the imperial eagle came fluttering to earth; indeed, the claims of the Cæsars to the ownership of metals in the earth have persisted to modern days. Under early English and German law any discovery of precious metals accrued exclusively to the Crown. Later this claim was modified if the ore contained the base metals as well as gold and silver. Such deposits of complex ore belonged to the owner of the soil, but were subject to a tax, which, being payable into the king's treasury, was known as a royalty, a word in which is preserved the idea of regalian prerogative. Later the rights of the landlord gained recognition, as in Cornwall, where the tinner paid a part of his product to the owner of the land, instead of paying it all to the king.

The origin of these prescriptions is obscure; some commentators trace them from the Roman custom, others ascribe them to independent usage in England. During the Middle Ages the idea of property in mines found expression in two conflicting theories. According to the first, the ruler was the absolute proprietor of ore deposits, and the owner of the soil had no rights save to a reasonable indemnity for any damage done by mining operations. According to the second theory, the ownership of the surface carried with it the ownership also of the mineral resources underground; but if the owner was unwilling or unable to exploit such resources he had to permit another to do so, both of them, however, being obliged to recognize the sovereign by the payment of a tithe. This, in effect, brought the two theories into accord.[1]

Medieval Struggle for Mining Rights

In Germany, the idea of regalian right was introduced at the time when, in the eleventh century, the assumption of the crown of the Cæsars coincided with the revival of Roman law. The code of Justinian and the constitution of Gratian were cited by the Lombard commentators in support of the pretensions of the German emperors, who thereupon took the miners under their peculiar care.

The history of mining during the medieval period records the struggle for an adjustment of rights as between the emperors and the feudatory princes, and as between these landlords and the miners, who, concurrently, became segregated into a class that was accorded special exemptions, duties, and privileges, in consequence of the skill acquired in the winning of the metals, and the increasing demand for the metals themselves. A period of migration marked the expansion of German mining between the eighth and twelfth centuries. This migration, stimulated by the discovery of silver ore on the receding eastern frontier, created novel legal conditions, among which was a scramble for the right to collect toll on the produce of the new mining districts. Kings and potentates of various degrees, including bishops, assumed possession of the mines, and operated them on their own account with the labor of their serfs. Others leased the mines as they had leased their agricultural lands, the lord either reserving for himself a share in the mine or taking a fixed proportion of the output. He, in turn, had to pay tribute to his over-lord, the petty princes to the dukes and kings, and these in turn to the emperor himself. A weak lord was compelled to concede rights to his superior; a strong one was allowed to share in the regalian exactions.

Some measure of order was brought out of this confusion by Frederick Barbarossa, who, in the twelfth century, established sundry principles that became established by usage; of these principles four were fundamental: (1) mineral ownership was separate from surface tenure; (2) the sovereign was the sole proprietor of the mines, and the only person privileged to grant to others the right of working them; (3) if he did not care to operate the mines himself, he retained a part proprietorship in the proceeds; and (4) the management was appointed and controlled by him.

More important, however, than the treatment of the mines as property was the treatment of the miners as human beings, for it was they who by their skill made the ore deposits a source of industrial wealth. The beginning of a recognition of the miner's better status

[1] "The Victoria History of Cornwall." Article on mining by George R. Lewis.

in the community is to be seen in the charter granted by the Bishop of Trent in 1185, by virtue of which all the miners in his domain were accorded "the right of tarrying, laboring, and going and coming in the mountains, in the city, and wherever they might wish, freely and without hindrance." Still more important was the right given the miner to "a measured plot of ground for pursuing his discovery of ore." The miner had ceased to be a serf; he was now an artisan.

Students of mining law do not agree as to the origin of the rights secured by the miner, in Germany and France, for example, during the medieval period. They agree as to the result, but not as to the cause, except that in general the rulers had discovered that if the production of metals was to be stimulated it had become necessary to treat the miner differently from an agricultural laborer. To work the mines properly it was imperative that the men be free from interruption and that skilled workmen be attracted to the enterprise. In consequence, the emperor and the feudal lords beholden to him were pleased to commute their rights to the mines for a part of the produce, and to throw open the mines to a special class of laborers under a series of charters by virtue of which they gained an increasing measure of independence. The competition between the territorial magnates for an adequate supply of skilled workers had the effect of aggrandizing the miners as a class; they became free not only from feudal subservience but also from military service; they were made answerable to a special court, in order to protect them from the ordinary magistrates with whom in the course of their prospecting they were likely to come in conflict. The effect upon the mining industry was immediate; when the miner ceased to be rated as an agricultural laborer the work of mining began to be something better than a mere grubbing in the ground; a technique was developed.

"Pegging" Claims in Cornwall

A similar change was in progress in England. At the beginning of the twelfth century the social and political status of the miner was that of the villein, or feudal serf. He was tied to the land, he was subject to the payments and services exacted by his lord; he gave part of his time to agriculture; his occupation as a miner was not specialized as yet, because it was not performed with special skill. In Cornwall, however, a custom had become established that had the effect of separating the miner from the ordinary agricultural laborer; this custom was known as "bounding"; it conceded the miner the privilege of searching for tin wherever it might be found. The poorest villein could become his own master simply by pegging a claim and registering its boundaries (hence the term "bounding") with the proper official, who, in 1198, became known as the warden. He was appointed by the king, and issued regulations that had the effect of making the miners accountable to him rather than to the ordinary courts, the result being to give the tin districts, or stannaries, a special political character.

The output of tin at this time, in the reign of Richard II, had increased to 450 tons per annum, so that it represented the major part of the revenue from Cornwall. To the growing importance of the industry the stannaries owed their first charter, granted by King John in 1201. For the English miners this charter was not less momentous than the Magna Charta, which the same king had to sign fourteen years later; it confirmed the custom of "digging tin and turfs for smelting it at all times, freely and peaceably and without hindrance from any man, everywhere in moors and in the fees of bishops, abbots, and counts. . . . and of buying faggots to smelt the tin without waste of forest, and of diverting streams for their works, and in the stannaries, just as by ancient usage they have been wont to do." Moreover, by removing the miners from the jurisdiction of the ordinary courts to that of the warden, they escaped finally from their feudal serfdom, and, ceasing to be villeins, became free men and artisans. The charter states that the privileges are granted because "the tinners are of our farm and always in our demesne." This statement indicates the idea underlying the momentous change in the miner's status: the king, by asserting his right to land on which ore had been discovered, claimed the discoverer as his own retainer, and thereby freed the miner from his feudal obligation to the previous owner of the land.

English Kings Help Miners

Furthermore, the king, presumably, desired to encourage mining as a source of revenue, and to accomplish this purpose he found it advisable to give the miners greater opportunity to search for the tin ore and exploit it without hindrance from their feudal masters. These, naturally, opposed the charter, and succeeded for a time in causing it to be revoked. King John had to give way to the barons in this as in other matters, but his successor, Henry III, restored the rights granted to the miners by John's charter of 1201, and in 1305 Edward I issued regulations that had the effect of further differentiating the tinners from the rest of the community. These regulations continued in force as the written constitution of the stannaries until within a century of our own day.

While the Cornish tinners were working their way to freedom, their comrades elsewhere in England were winning similar recognition. In the Forest of Dean, the iron miners were given a charter by Edward I by which the right of free mining was accorded to every dweller in the forest, and with it went the right of access for his ore to the king's highway, so that the road to market was made open. In the lead-mining district of the Mendip hills, the territorial magnate, who was the Bishop of Bath and Wells, tried to deny the rights of the miners, whereupon the king, Edward IV, caused an inquiry to be made, the result of which was to embody the miners' customs into written law. The right to dig ore was allowed to anyone who first made application to the landlord and who would agree to pay "every tenth pound of lead blown at his hearth," or smelting furnace. The length of a miner's claim was the distance he could throw an axe.

Fifty-eight Yards Along the Vein

In Derbyshire, it was the custom for the miner,[2] as soon as he found ore, to fix a cross in the ground as a mark of possession; then he gave notice to the barmaster, who was analogous to the *berg-meister* in Germany or the warden in Cornwall. This official in Derbyshire was "chosen by the miners and merchants to be an impartial person between the lord of the field and the miners, and between the miners and merchants." The barmaster received "a measure of ore," and there-

[2] "Compleat Mineral Laws of Derbyshore," 1734.

upon allowed the miner two meers along the vein, a meer being 29 yd. long and 14 yd. wide.

The origin of these unwritten laws is obscure. In the mining districts it is said that they are derived from usage time out of mind. The charters that were granted by the kings in the thirteenth century appear merely to have confirmed immemorial custom, just as the American mining law of the nineteenth century was based upon the regulations that had been formulated by the diggers in the mining districts of California and Nevada. The creation of special courts for the miners in medieval England had the effect of placing the miner and his fellows, within specified districts, "in a state within a state," as Lewis says. They paid their taxes as miners, not as Englishmen; they were subject to no feudal levy; they took orders from the king only through the warden. Apparently any villein could obtain complete release from serfdom simply by pretending to be a miner, and in that capacity proceeding to dig into the ground of his feudal lord or of his lord's neighbor. The reasonable interpretation for this anomaly is, as Lewis suggests,[3] that the sovereign claimed all metal mines and enforced his claim wherever practicable. In the long struggle between the landlord and the miner, it suited the exigencies of regal revenue that the king himself should be on the side of the miner and against the feudatory princes on whose lands the ore was discovered.

Out of the contest over legal rights came the idea of mining as an occupation to be conducted under the immediate supervision of the state; to this idea the miner owed his liberation from serfdom and his segregation into a class of free laborers made exempt from sundry forms of taxation. Thus he became the possessor of privileges that had the effect of raising his status in the medieval community. At the same time it is natural that these concessions should have exasperated the landlords, and it is not surprising that the miners occasionally overstepped their privileges, and caused trouble thereby. In 1237 the English king, Henry III, heard a complaint from the clergy that the miners of tin, lead, and iron were digging in land that belonged to the church. Eighty years later the people of Devon complained that the miners were destroying their tilled fields, woods, and gardens; to which the tinners replied that the local magnates "were impleading them for pleas of serfs." Evidently the miner's social status was still challenged in places.

Miners Take Advantage of Their Position

In 1318 another complaint was made from Devon that the stannary men assaulted citizens outside the boundaries of the tin districts and yet refused to be brought to justice, and when approached by the bailiffs they imprisoned these officers of the law until a ransom was paid. Apparently the wine of freedom had gone to the heads of the miners, and they had adopted an aggressive attitude. The struggle continued. In 1347, again from Devon, into which tin mining had spread from the adjacent county of Cornwall, comes complaint to the king that "under cover of the king's charters the tinners claim all manner of lands, arable or otherwise, overturn fields and woods, and turn the courses of streams, whereby the land is become wasted and barren." To the ordinary citizen the miner had become a public nuisance. The troubles of the Devonshire tinners remind one of the hydraulic miners in California forty years ago, when the silt washed from the alluvial workings in the foothills of the Sierra Nevada overspread arable land in the Sacramento valley, and threatened, so it was claimed, to choke the navigable streams. The Californian miners had no king to protect them, for revenue only, but a popular government under which the rights of one class might not be exercised to the detriment of another class, especially one so important as the agricultural, in consequence of which the mining operations were restrained by the federal regulations known as the Debris Act of 1882.

As might be expected, the favored status of the miner was claimed by persons not entitled to it. The earliest document in which the "tinner" is defined is an official letter dated 1198 in which the term included "all diggers of tin, buyers of black tin, first smelters of tin, and merchants of tin at the first smelting." The charter of 1201 affected "all tinners as long as they are at work"; that of 1305 confines its scope to miners "on the king's ancient demesnes." In 1876 a complaint was made by petition to Parliament that not only working miners, but their employers also, enjoyed the freedom of the mines. The result was to define the "tinner" as a manual laborer in the mines and smelters, and for so long as he worked there.

Owners of Smelting Works Get Privileges

In 1507, under Henry VII, a pardon was granted to the tinners for their disregard of certain ordinances, and in the charter of pardon they, named in the Latin text as *stannatores*, were described as gentlemen bounders (or locators), owners of tin works (or concentrators), proprietors of blowing houses (or smelters), and buyers of tin. This broader interpretation of the term persisted through the centuries despite objection from the ordinary courts of law, which found their jurisdiction invaded by the stannary courts.

The inclusion of the managers and agents of the smelters, and of the buyers and sellers of tin, was not done to give them the privileges of the miner, but to enable the latter to bring suit against them in the stannary courts in the event of any cheating or other malfeasance, and to render such persons at all times subject to the regulations of the stannaries. This idea became established; it is embodied in the Stannary Acts of 1837 and 1855, by which "all adventurers, agents, laborers—in short, all connected in any way with mines, either in supplying materials or otherwise —are held to be miners and may sue and be sued in the stannaries." Thus, whereas the desire to be included among the tinners went at first with the purpose of obtaining a privileged status, it is probable that later it connoted the wish to use the stannary courts in technical cases arising out of disputes connected with the mining and smelting business. A desire for a similar institution has been expressed often in later days by American miners, who likewise wish that mining litigation might be referred to a court especially constituted for the adjudication of such matters.

The status of the law in England at the close of the medieval period is indicated by the fact that in 1426 the king, Henry VI, gave the Duke of Bedford a ten years' lease of all the gold and silver mines in the kingdom, on the condition that he pay a tenth of the product to Holy Church, a fifteenth to the king, and a twentieth part to the owner of the soil. The origin of this "pretence," says Pennant, is to be found in the king's right

[3] "The Stannaries," by George R. Lewis, p. 75.

of coinage. In Elizabeth's reign this royal prerogative was asserted confidently; she gave to two skillful German miners, Daniel Hochstetter and Christopher Shutz, in 1563 and 1564, the most comprehensive grants to mine all kinds of minerals, and authorized them "to sink shafts wheresoever they pleased (gardens excepted), and to build houses requisite to carry on the works not only upon the royal demesnes but in the grounds of any of her subjects." When the Earl of Northumberland questioned the Queen's title to the copper mines of Keswick, he received an adverse legal decision, which stated that "although the Crown had the power to grant away its manors, it had not the power to alienate the mineral, being perfectly linked to the prerogative of the Crown." Not until the revolution that ended the Stuart régime were these pretensions squelched. In the first year of the reign of William and Mary—in 1689—the right to base-metal mines was relinquished, even though the ore contained gold and silver also. Blackstone, in his "Commentaries," writes thus:

"The right of mines has its original from the king's prerogative of coinage, in order to supply him with materials; and therefore those mines which are properly royal and to which the king is entitled when found are only those of silver and gold. By the common law, if gold or silver be found in mines of base metal, according to the opinion of some, the whole was a royal mine and belonged to the king; though others held that it only did so if the quantity of gold or silver was of greater value than the quantity of base metal. But now by the statutes (of 1689 and 1693) . . . this difference is made immaterial; it being enacted, that no mines of copper, tin, iron, or lead shall be looked upon as royal mines, notwithstanding gold or silver may be extracted from them in any quantities; but that the king, or persons claiming royal mines under his authority, may have the ore (other than tin ore in the counties of Devon and Cornwall), paying for the same a price stated in the act. This was an extremely reasonable law, for now private owners are not discouraged from working mines through a fear that they may be claimed as royal ones; neither does the king depart from the just rights of his revenue, since he may have all the precious metal contained in the ore, paying no more for it than the value of the base metal which it is supposed to be; to which base metal the land owner is by reason and law entitled."

Copper Ore Brought £16 per Ton in 1787

Blackstone wrote in 1787. The act to which he refers provided that the Crown had the right to purchase "within thirty days after raising, all ores made merchantable, at the following rates: copper at £16 per ton, tin at £40, lead at £9"; and in default of such payment the owners were at liberty to dispose of their ore as they pleased. This law soon passed into desuetude, leaving the Crown with rights only to mines of the precious metals.

We have seen how the delimiting of a mining claim, as exemplified by the old custom of bounding, in vogue eight hundred years ago, gave the prospector not only the economic right to dig for ore but also the civic opportunity to escape from feudal bondage. That opportunity and that freedom alike were the inalienable rights of the miner when in the middle of the nineteenth century the discoveries of gold in California and Australia caused a great migration of adventurous men to the diggings, and started a systematic search for the metals all over the world, with results that are told eloquently by the statistician. The long line of gold-seekers that like a swarm of ants climbed the Sierra Nevada and established their frontier communities in the pine-clad canyons of the Californian foothills were bound by no written law of mines. The Mexican regulations had become inoperative when the region was ceded to the United States, shortly before the newcomers arrived, and the American law of mines was as yet undeveloped, for the few acts of Congress on the subject were local in their incidence, and applied only to particular lead and copper districts in Missouri, Michigan, and adjacent mid-western states. It must be remembered that the mining industry of the United States, now grown to colossal dimensions, was in its infancy in 1848, when gold was discovered in California.

Federal Acquisition of Mineral Resources

In the Crown grants to the original colonies a fixed proportion of the precious metals from mines was reserved for the sovereign, and when the colonies became independent states they made similar reservations. By cessions of territory from several of the American states and by the extension of territory westward under the terms of the Louisiana Purchase in 1803 and of the treaty with Mexico in 1848, the Federal Government acquired a public domain of vast extent, with the mineral resources contained therein. Under a law passed in 1807 an effort was made by the government to lease its mineral lands, with payment of royalty, but the attempt proved an utter failure, the income for the years 1841-1844 "being less than one-fourth the expense," as stated by President Polk in his first message to Congress. Thereupon a new system of selling mineral lands, usually at a price of $2.50 to $5 per acre, was introduced; and it was operative in several states at the time when a wholly different set of conditions was created by the intensive exploitation of the Californian gold fields. That picturesque event marked an entirely new departure in mining law, as well as the birth of a new mining industry, to be associated with the most expansive ideas of human freedom and economic development.

Into the mountains there poured a stream of energetic pioneers; in the canyons they found deposits of gravel rich in gold, which had been concentrated from the products of erosion by the patient operations of nature for periods of geologic duration; it was a treasure waiting to be gathered by the first comer intelligent enough to appreciate its value. To the diggers it was a No Man's Land; the common law of the eastern states had no bearing on the mining problems presented in the golden gulches of the Sierra Nevada; the Mexican law was dead by act of war, by treaty of peace, and by the absence of the necessary officials. The region of the mines was without any organized government, the military commander in California, Colonel Mason, having decided to make no attempt to demand any rent or royalty from the diggers; he resolved "not to interfere, but permit all to work freely."

The gold seekers, of course, were trespassers technically;[1] the land on which they worked belonged to the Federal Government; it was unsurveyed, and therefore not open either to occupation or to settlement; but the government, when it began to realize the condition of affairs, decided wisely to let well enough alone and to permit the people on the ground to formulate their own regulations. This the diggers did sagaciously. As soon as a mining center had become established, they called a meeting of those in the vicinity, elected officers, or-

[1] "Lindley on Mines" and "The Extralateral Right," by William E. Colby.

ganized a district, and drafted a simple code of local rules. These rules dealt in the main with the mining operations, but in many cases they dealt also with civil rights and the punishment of certain crimes.

The main purpose of these local rules was to fix the size of the claims, the manner in which they were to be marked, the amount of work necessary to hold possession, and the circumstances under which a claim might be considered abandoned or open to relocation. Each district formulated its own regulations, but they bore a similarity that indicates sundry ideas in common, the precise origin of which is doubtful. Some knowledge of Mexican ordinances on the part of the gold seekers has been asserted, but chiefly by persons interested in claiming rights from the former owners of the soil. Among the pioneers were men acquainted with the character of mining operations in other countries, including England and Germany; in the regulations that they devised are hints of customs peculiar to Derbyshire, Cornwall, and the Harz; it is likely therefore that to the old mining districts of Europe are owing the basic ideas that underlie the American law of mines as first established in California.

The right of discovery was recognized, together with that of appropriation, as the foundation of the miner's title; and the continuous development of the claim by working was the accepted condition of retention. Absolute equality of right and privilege was recognized as a fundamental principle. The first appropriator of a delimited piece of ground was regarded as the original owner, from whom title was to be traced.

"With the Dips and Angles"

The early mining was restricted to the exploitation of the placers, or alluvial deposits, and therefore presented few legal difficulties. When, however, in a year or two, the working of the quartz veins, the source of the detrital gold, was started, the simple placer laws were found inadequate. It became necessary to recognize the fact that a vein in its inclination, or dip, soon ran out of the small rectangular area of an ordinary placer claim. So vertical boundaries were abrogated. For example, the regulations of the Saunders Ledge mining district in 1851 provided that "one hundred feet on the ledge *with the dips and angles* shall constitute a claim."

Here we have the first appearance of the so-called extralateral right, which has added so greatly to the complexity of the American mining law. Where did the diggers get the idea? This question, as Colby says, is never likely to be answered with confidence, because no records survive to tell us what the framers of these Californian regulations had in mind. Such terms as "dips and angles" are of old English origin; under the Derbyshire custom it was not the land but the privilege of working the mine that was granted the miner; the vein was the principal thing; the surface was incidental; the miner had the right to follow the ore to unlimited depth. That suggests the extralateral right. Moreover, the German miners that came to the American diggings may have brought the same idea with them, for it was recognized in their country at one time; it had been abolished in their day, it is true, but the vested privileges under the old law were still recognized, and therefore must have been known to those of them who came to the Sierra Nevada. That law gave the right to mine between parallel planes, following the ore in depth on either side with all its twists and turnings, and therefore differed fundamentally from the American law, which restricted the right to the vein itself where it dipped beyond the side lines of the claim. The diggers in the Drytown district, for example, resolved on June 7, 1851, only a day after the Saunders Ledge mining district had been organized, "that the size of a claim in quartz veins shall be 240 ft. in length of the vein *without regard to the width*." This phrase is reminiscent of the old German phase of the extralateral right.

The various regulations adopted by these frontier communities had much in common, and continued usage tended to give them a similar interpretation, so that when Congress finally decided to sanction these proceedings by an act of legislation the fundamental principles had become developed and standardized in the mining districts. The State of California, organized in 1850, made no attempt to legislate on the subject, except to approve of what the miners had done on their own initiative. Thus a system of free mining had been fostered by the neglect of the Federal Government, and had been matured by its generous inaction. The clear trespass of the pioneers had become recognized as establishing a right through sufference, as Colby says. Therefore, Congress, when it took the matter in hand, in 1866, made no attempt to disturb existing legal conditions; on the contrary, it passed a law that confirmed the local regulations. We must not suppose, however, that this sagacious decision to recognize the validity of the regulations already in force in the mining districts was reached without some questionings. Various abortive attempts were made previously to legislate on the subject; among these was one plan to lease the mineral lands, reserving a royalty for the government, and another to sell them outright at public auction, for the purpose of liquidating the national debt incurred during the Civil War.

It became evident to the Senators from the mining states, notably Senator Stewart, of Nevada, and Senator Conness, of California, that something had to be done to forestall adverse legislation on the part of those not in sympathy with the mining communities of the West. The bill introduced in 1866, as stated by Conness, aimed "to adopt the rules and regulations of miners in the mining districts where the same are not in conflict with the laws of the United States." Stewart said: "In the increasing agitation of the subject by the introduction into Congress of bills which miners regard as a system of confiscation, and which tend to destroy all confidence in mining titles, we now need statutes which shall continue the system of free mining, and hold the mineral lands open to the exploration and occupation, subject to legislation by Congress, and local rules; something which recognizes the obligation of the government to respect private rights which have grown up under its tacit consent and approval." Again he said: "This whole bill is based upon the principle of confirming what has grown up out of necessity, the wisest system, perhaps, that could possibly be devised, which is the work of the people themselves."

If the existing regulations had been ignored, and if, by an entirely new set of regulations, the properties of the miners had become, in effect, confiscated, the result would have been disastrous to the mining industry, in which by this time millions of dollars had become invested, and in which thousands of good citizens had become inextricably interested in an honorable and useful way. The primary idea was to leave the public

domain open to exploration and thereby to encourage the industrial development of the mineral resources of the United States. It was a wise decision and it was carried out in good faith. The law of 1866 confirmed the rules framed by the miners, and gave them in addition the opportunity to secure title in fee simple by means of a patent on their locations.

Among the principles adopted was that of the extralateral right. Whether this was a blunder or not is open to debate. In any event, the blunder, if it be such, cannot be charged against the lawyers, who have thrived on the litigation that it has incited, but to the thoroughly democratic meetings of the diggers that first introduced it into their code. By the time Congress took the subject in hand this feature of the local regulations had become firmly established, and any change was regarded as impracticable. The law of 1872 confirmed it, but at the same time corrected sundry defects in the law of 1866, such as the delimitation of the width of the mining claim and its rectangular shape.

Establishment of Extralateral Rights

Thus the extralateral right became a distinctive feature of American mining law; it was the product of an elementary knowledge of ore deposits, for it postulated a regularity and continuity of lode structure such as does not exist in nature. If veins were of the simple tabular type assumed by the law, it could have been applied to mining operations without trouble, but the irregularity and indefiniteness of the boundaries of ore deposits have become well recognized in later days. Ore is an economic, not a geologic, term; its limits are determined not by eye, but by assay. Nevertheless, it is only fair to state that the extralateral right has been responsible for a much smaller share of litigation than is generally supposed, and today, owing to vested rights, any repeal of the apex law—as it is called—probably would cause as many complications as it would correct.

In Australia also the idea was introduced, but it failed to survive. At Maldon (Victoria) in 1857 the local regulations gave the owner of a claim the right to follow the "reef" to whatever distance it might dip; and in New South Wales, in 1858, the law provided that the miners could "follow and work a quartz reef or vein in any direction that such reef or vein may take"; but the privilege was restricted to veins that dipped at an angle of not less than 20 deg. This is reminiscent of the old German regulation on the subject, and probably came to Australia through men that had been in California. In 1866 the existing system of vertical boundaries was adopted, because the extralateral right was "found to lead to disputes."

Both in Australia and in the United States some of the early British grants contained reservations of certain minerals.[5] In 1840 the British Secretary of State, Lord John Russell, informed the Governor of the Australian colonies that henceforth all deeds of grant should convey to the purchaser "everything below and everything above the surface." He advised the Governor not to reserve lands "merely because supposed, or even certainly known, to contain useful mineral substances"; and he added the remark that "the small amount of profit derived from mines throughout the great extent of the British colonial empire would appear to us sufficient reason why such reservations would, as a general rule, be as unnecessary as they would be inconvenient to the progress of the settlement."

Evidently he and his associates had as little idea of the enormous wealth contained in British territory as the founders of the United States had of the mineral riches of the continental area that came under the American flag, for Benjamin Franklin in 1767 said, when advocating the use of paper money, that "gold and silver are not the produce of North America, which has no mines." In 1923 the mineral production of the British commonwealth was worth $2,000,000,000, of which half (chiefly coal) came from the mother country, and in the same year the United States yielded minerals to the value of $4,000,000,000. Evidently little was known, and not more was surmised, concerning the mineral wealth of the English-speaking countries, and of the part that this natural resource was destined to play in the industrial advancement of undeveloped regions.

The excited migration to the gold fields of Victoria in 1852 had much in common with the rush to California in 1849; indeed, the discoveries made in Australia, first in New South Wales and then in Victoria, were aided by the experience gained previously in California. At that time as many days had to be spent in communicating between the Australian diggings and the seat of government in London as between the mining camps of California and the city of Washington. At first the pioneers in the Australian bush were left to themselves and had to organize their own communities, but this primitive stage of political development did not last for more than a few months, because the administration of justice under the English law was established in the colonies, and the diggers soon found themselves under the restraining hands of constituted authority.

The Governor of New South Wales, which then included Victoria, had no thought of imitating Colonel Mason's *laissez-faire* policy; on the contrary, Governor Fitzroy stated promptly that order must be preserved, and if the preservation of order necessitated the employment of troops and the consequent expenditure of money, then the cost of it would have to be borne by those—the miners—who would be protected and benefited thereby. On May 22, 1851, the Governor issued a proclamation in which he asserted the common-law right of the Crown to all the gold mines, and gave warning that anyone removing gold or digging the soil in search of such gold, without being fully authorized, would be prosecuted. In other words, in Australia, as in California, the diggers legally were trespassers. The Governor ignored Russell's instructions, and also the land regulations of New South Wales. He used the traditional regalian right as a means for asserting jurisdiction over the gold fields. Every digger was compelled to procure a license from the government and to conduct his operations in accordance with the law of the land. The Australian diggings were not a No Man's Land; they were an integral part of Her Majesty's dominions.

In July, 1851, Victoria was made a colony separate from New South Wales, and a lieutenant governor named Latrobe repeated the proclamations and regulations issued two months previously by Governor Fitzroy. At that time the output of gold in Victoria was at the rate of $1,000,000 per week, and, as might be expected, great excitement prevailed. The license fee was increased from 30s. to £3; it had to be paid by everybody on the gold fields, including cooks and teamsters, for example. This was one cause of the unrest

[5] "Mining Laws of Australia and New Zealand," by A. C. Veatch, 1910.

that culminated in a riot at Ballarat in 1854. A contributory cause of trouble was the corrupt conduct of sundry petty officials and the opportunities for blackmailing afforded by some of the regulations. Bloodshed ensued when the military endeavored to enforce order.

"Miner's Rights" at Twenty Shillings

This was followed by the appointment of a commission to investigate the questions at issue, and the report of that commission, in 1885, led in due course to the enactment of a new mining law. The license, at 30s. per month, was replaced by a permit more pleasantly named a "miner's right," which cost only 20s. per annum. The new law provided also for a local court, composed of a chairman appointed by the Governor and nine holders of miner's rights, elected by the miners in the district. This law proved satisfactory in its operation. Changes were made as experience proved that they were needed; but when placer mining gave place gradually to vein mining, as in California, there came a demand for important alterations. Another commission was appointed to study the question, and from the report of that commission sprang the statute of 1885, which to Australian mining is as fundamental as our law of 1872 is to American mining.

Continuous Development Required in Australia

The basic principle of the Australian law is that a mining claim shall not be held without continuous development; if one man does not work the ground, another shall have the opportunity to do so. Such was the fundamental idea among the Californians also; it was a corollary of the one man-one claim postulate, which, however, was set aside on the American gold fields when the use of capital became a dominant factor in mining enterprise and the owners of mining property began to hire others to do their work. This led, in the United States, to the holding of several claims by one person and the substitution of an amount of work of given value ($100 per annum) in lieu of the labor formerly required from the claimholder himself. Thus a rich man could own a number of claims without working on any of them personally. Absentee ownership became a fact.

Next, and worse, the original idea of continuous development was discarded altogether when the American law permitted the claimholder after five years to acquire title in fee simple to the ground by spending $500 in development and improvements, thereby obtaining a patent to the property. In Australia the original idea was retained, with wise modifications; when mining operations passed beyond the one man-one claim stage, especially in vein mining, which needed the co-operative effort of several men, the leasehold system was introduced. At first the lease was granted on a royalty of 5 per cent, but this proved so unpopular that the royalty was discarded in favor of a rent of 5s. per acre per annum. The labor covenants—that is, the number of workers required to retain a lease—were fixed by the local court of the district; the requirement varied from less than one to more than three men per acre. Now the usual requirement is two men per acre on claims of twenty-four acres and one man per three acres on claims covering sixty acres, with progressive decrease per unit as the area is increased. On large properties the expenditure of capital in equipment and improvements is allowed to count as development; that is, the required amount of labor can be expressed in money instead of men. No man may locate a claim without obtaining a miner's right, which in the several states now costs only from 2½ to 5s. per annum.

The size of claims, the number of them, the conditions of consolidation, the labor requirements, and other matters of this kind were left at first to the local mining boards, which acted commendably and with a view to the welfare of the industry. In California such local authority was created by the miners in public assembly. In Australia the same thing was done by parliamentary enactment. The local boards, however, have outlived their usefulness now, and the administration of the mining districts has passed largely to the mining department of each state.

Patenting a Measure for Security

The miner, both in Australia and the United States, can hold the claim that he has "pegged" or "located" by working on it continuously, but for greater security, especially such as is required for the larger enterprises of joint stock companies, it is customary to obtain a lease in Australia and to acquire a patent in America. The patent gives absolute possession, even as against the government, and permits the owner to cease work entirely at his pleasure, whereas the lease leaves the claim holder under the obligation to perform a fixed amount of work annually. So the American system is safer for the capitalist, but it has the obvious defect of alienating parts of the public domain permanently, and of allowing the ground to pass into the hands of persons that may hold it unproductively.

Meanwhile, how was the status of the miner, as an individual, affected by these events? From slave to serf, from serf to artisan, he had advanced during the long centuries, and when as an adventurer he set out on his golden quest to Australia and California he was at the height of his social advancement; he was his own master, the world was his oyster, and he had but to use his own pick to pry it open, in search not of pearls but of nuggets. The diggers in Australia were free men; they had the zest of discovery and the joy of achievement, but, almost from the beginning, the hand of the government was on them and they knew the trammels of political subjection.

Nearest Approach to a Democracy

The gold seekers in the Sierra Nevada, on the other hand, were free from all such ties; they had liberty such as no men ever had; to them the world was young, and life an epic. Owing to the absence of government and the opportunity given the diggers to organize themselves, they enjoyed a personal independence that was ideal. For the first two years—1848 and 1849—those groups of hardy men in the gulches of California represented the nearest approach to a democracy that the world has seen. Each man was a unit, each one had a say and a vote, each was the equal of the other in that frontier community. The absence of women and children simplified the state of society; it was a company composed of young men, more energetic and more intelligent than the average of mankind. They were mostly Americans of good antecedents. During those first two years they worked in parties of two or four; the search for gold involved strenuous labor, but it required nothing more than pick, pan, and muscle.

The era of machinery and capital, of the large combinations of men and money, was yet to come. Mining was simple and life was romantic. The democracy of

those pioneers was a genuine democracy; it was one that puts Athens to shame, for she restricted citizenship to a few and worked her mines with slave labor. In California a servile relationship was not recognized; the Southerners who came thither with their negroes, and the Chileans who were accompanied by their peons were not allowed to locate claims in the names of their bondsmen. The little settlements in the Sierra Nevada may have lacked sundry refinements; they had no temples or statuary, and few books, but the aisles of the forest were their sanctuary, the mountain peaks were fresh from the hands of the Great Sculptor, and in the running stream they read the story of the long process by which the gold had been concentrated for them into a treasure of exceeding richness. The foothills of California still glow with the romance of those wondrous days; and it is right that they should, for the episode of the gold seekers in California represents the apotheosis of the miner.

For two or three years he had a glorious time. So long as his own regulations were the law, and he could find treasure for himself by swinging his own pick, he continued to enjoy a freedom that appealed to the fundamental instincts of his manhood. But the tentacles of a complicated civilization closed upon him. Women came, and the social coil that they create. The predatory elements of human society, male and female, introduced many difficult problems. The working of small mines by individuals or partners on a petty scale gave place to co-operative effort on a large scale by joint stock companies. The rich deposits of ore became exhausted, and the poorer ones needed much machinery and capital for their development.

The Glory Is No More

The miner became a wage earner again. The freedom of a frontier democracy was exchanged for the veiled tyranny of a labor union. Mining lost its savor to the virile and adventurous type of man; he turned to other occupations for a livelihood, and in his stead there came to the mines the alien, the Mexican Indian and the reject of Europe, whose inferiority was masked by the aid of machines of great ingenuity. The free miner, the heroic youth of the Argonauts, was succeeded by the hired mechanic; the increasing complexity of the civilization that he had helped so largely to build, by his gift of metals, proved his undoing. The democratic ideal was submerged by industrial progress.

Increased Prosperity for the Zinc Industry

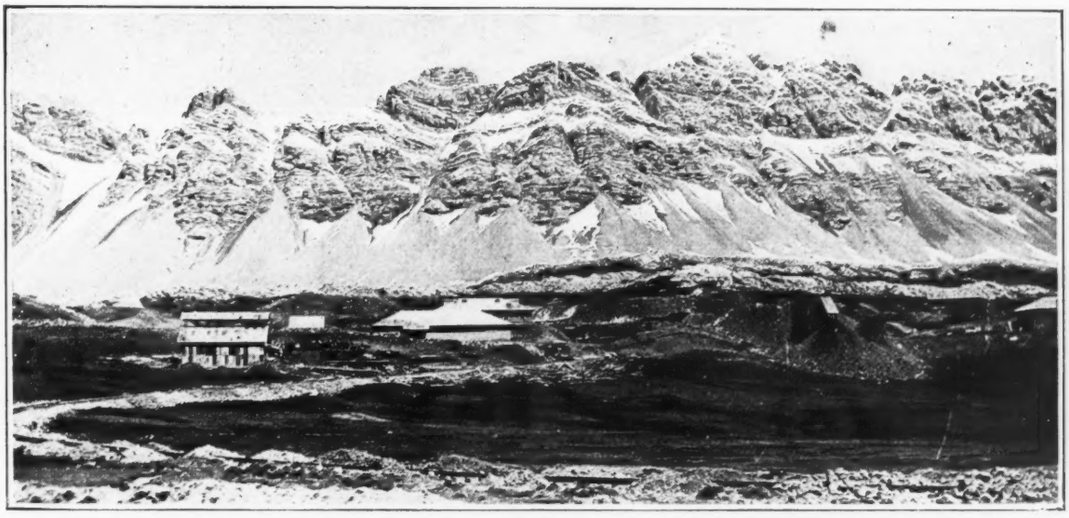
The U. S. Department of Commerce announces that according to data collected at the biennial census of manufactures, 1923, the establishments engaged in the smelting and refining of zinc reported products valued at $94,183,900, an increase of 151.3 per cent compared with 1921, the last preceding census year. Of the 35 establishments reporting for 1923, nine were in Oklahoma, eight in Illinois, three each in Arkansas, Kansas, Pennsylvania, and West Virginia, and the remaining six in Colorado, Indiana, Tennessee, and Texas.

The statistics for 1923 and 1921 are summarized in the following statement. The figures for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

	1923	1921	Per Cent of Increase (*a*)
Number of establishments	35	29	.....
Wage earners (average number) (*b*)	11,918	5,778	106.3
Maximum month	June 12,252	Jan. 7,368	.....
Minimum month	Sept. 11,645	Aug. 5,109	.....
Per cent of maximum	95.0	69.3	.....
Wages	$16,895,864	$7,243,760	133.2
Cost of materials (including fuel and containers)	$64,134,114	$24,312,208	163.8
Products, total value	$94,183,900	$37,482,675	151.3
Value added by manufacture (*c*)	$30,049,786	$13,170,467	128.2
Horsepower	69,583	(*d*)	.....
Coal consumed (tons of 2,000 lb.)	2,004,537	(*d*)	.....

(*a*) Per cent not computed where base is less than 100.
(*b*) Not including salaried officers and employees. Statistics for this class will be given in final report.
(*c*) Value of products less cost of materials.
(*d*) Not reported.

Mina Ragra, Peru. Camp and mine of the Vanadium Corporation of America

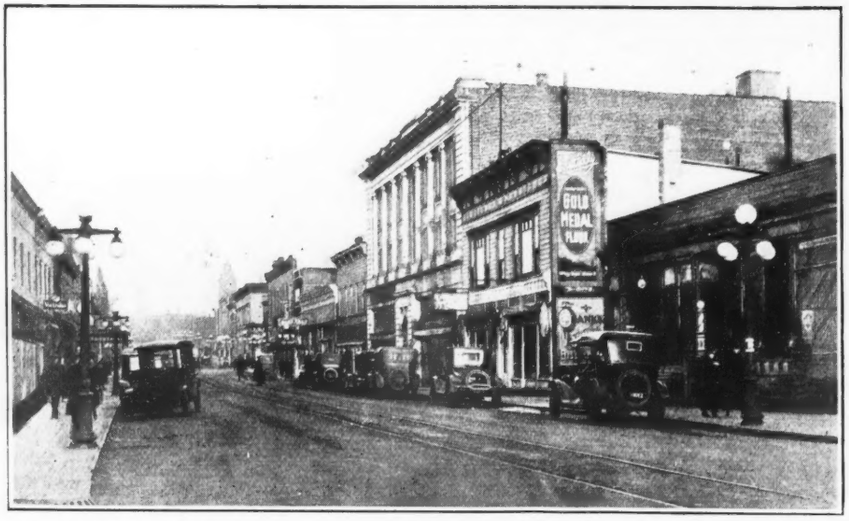


In the foreground is seen the 30-in. gage railroad of the company. At the right are the mine workings, at 15,500 ft. elevation. The cordillera in the background is composed of magnesian limestones of Lower Cretaceous age. The peaks are 17,000 to 18,000 ft. high. (See front cover.)

Then and Now in the Michigan Iron Country
Ironwood, 1885-1924

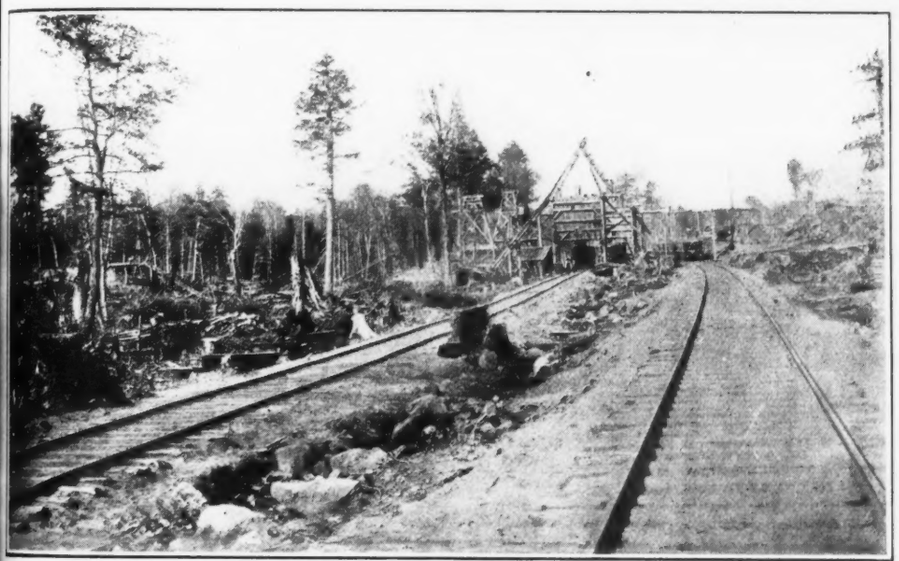
Left. Prospectors' camp on the Gogebic iron range in 1885, near Ironwood

Right. Street in Ironwood in 1885

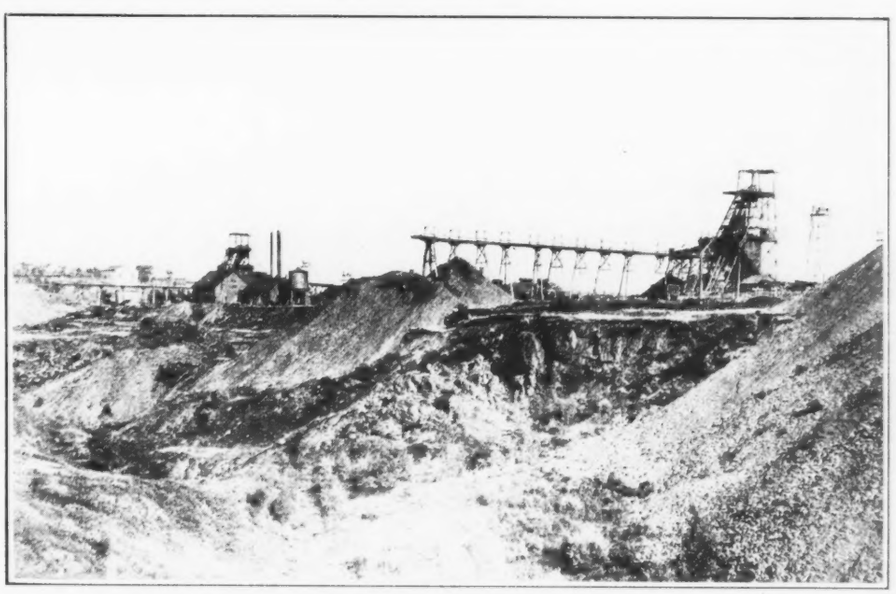


Left. Ironwood, the mining center of the Gogebic Range, as it appears today

Right. No. 2 shaft, Norrie mine, showing caved surface in foreground. Ironwood, August, 1893



Left. First shaft sunk on the Norrie mine, 1886



Right. Norrie mine today. One of the properties of the Oliver Iron Mining Co.

Discussion

Does the Tariff on Lead Help the Domestic Lead Producer?

THE EDITOR:

Sir—*Mining Journal-Press* a few weeks ago published some statistics to show that in the third quarter of 1924 domestic deliveries of copper were 50,000 tons less than the average, for the first two quarters, but export shipments had declined much less—by only 5,000 tons. In *Mining Journal-Press* of Nov. 15, figures for the first three quarters of this year are given so as to prove conclusively that the exportable surplus of copper in the United States is increasing.

Business in this country during the third quarter of 1924 was not active. No proof is needed to establish this fact. But it is questionable if the figures mentioned above do any more than establish the fact that copper consumption shared in this slump. It may or may not have been a pre-election hesitation, but it is certain that the condition was only temporary. In the last few weeks, copper consumers have been booking business on a large scale. The third quarter of 1924 was a minor and unimportant slump. When the question of our exportable surplus of copper is viewed in a larger way it is seen that in 1913 this surplus was more than 42 per cent of our own production. In 1923, according to *Mining Journal-Press*, the exportable surplus was only 8 per cent of the domestic production. *Mining Journal-Press* figure for 1923 is a maximum because it includes brass and bronze in manufactures exported as containing 80 per cent copper.

Rather than focus attention on the third quarter of 1924, why not examine the course of domestic production and consumption in 1924 compared with that of 1923? September, 1924, mine output is, at an annual rate, 3.4 per cent above the 1923 production. In spite of any slumps, 1924 consumption in this country has so far run higher than in 1923, by considerably more than 3.4 per cent, according to the Copper and Brass Research Association.

Copper and lead are in similar positions. In each case domestic consumption is about equal to domestic production. There has been a tariff on lead for a long time. This tariff has stabilized the lead market. Consumers are not worried by causeless drops of a fraction of a cent a pound every time there is a little lull in buying. Producers gain more from this stabilization than consumers, but both sides are benefited.

In the five years ended 1913, domestic lead consumption was about 400,000 tons annually. The annual foreign trade in lead ran close to 75,000 tons exported and 75,000 tons imported. There was an export surplus of 9,000 tons over this period. Lead ores imported offset this and gave surplus imports of 59,000 tons for the five years. Figures for lead in manufactured form are not available. In the war period (1915-1918) the United States had an export surplus of 166,000 tons of lead (46,500 tons yearly). In each year except 1917 the domestic output exceeded the domestic consumption. From 1919 to 1922 inclusive there has been a surplus of imports of 180,000 tons. The records by quarters since 1922 are shown in the table immediately following (in tons).

Year	Quarter	Exports	Imports	Surplus Imports
1923				
	First	10,000	35,000	25,000
	Second	48,260	38,000	(a) 10,000
	Third	20,500	21,300	800
	Fourth	17,100	45,750	28,650
1924				
	First	12,500	36,100	23,600
	Second	16,700	37,450	20,750
	Third	31,500	36,080	5,580

(a) Deficit

Is it safe to say that the lead tariff did no good in the war period; that it was useless in the second and third quarter of 1923 and will soon be of no use whatever, because the surplus of imports is decreasing in 1924? Let us look at the price of lead in London and New York in these periods.

From 1909 to 1913 the average price of lead in New York was 4.426c. per lb.; in London 3.302c. New York was 34 per cent higher. In the period 1915-1918 inclusive the New York price was 6.92c.; London, 6.06c. New York was 14 per cent higher. In the period 1919-1922 the New York price was 6.04c.; London, 4.98c., New York being 21 per cent higher.

For 1923 and 1924 the average prices by quarters are as follows:

Year	Quarter	London Cents	New York Cents	New York Higher Per Cent
1923				
	First	5.90	7.95	34.7
	Second	5.40	7.50	38.8
	Third	5.30	6.53	23.2
	Fourth	5.85	7.00	19.6
1924				
	First	6.60	7.975	20.8
	Second	6.05	7.517	24.2
	Third	6.40	6.558	2.5

The above average price figures are taken from the standard authorities. The records of imports and exports for lead are the U. S. Department of Commerce figures from 1915 to date. The pre-war figures are from *Metallgesellschaft*, twentieth annual issue. London prices have been converted into cents per pound on a basis of monthly average figures for sterling exchange furnished by the First National Bank of Boston.

New York. F. WARD PAINE.

"Deep and Narrow"?

THE EDITOR:

Sir—Your editorial in the Nov. 15 issue regarding Professor Ely's conception of fool's gold seems a little hard on the professor. Do you realize that literally hundreds of people from all over the country are constantly sending in mineral specimens to the U. S. Geological Survey for identification and that it is extremely common for many of them to call their material metal when they mean rock or mineral, to ask for an analysis when they mean "What is it?" and that they are generally well pleased to learn what the substance is, even if it is not gold? Yellow mica is frequently mistaken for gold, even by intelligent persons; it certainly fools them, though it may not be the original fool's gold. Pyrite may not be a metal, but how about "road metal," an expression often used to indicate ballast, or one might even quote Shakespeare, "And if thou hast the metal of a king," and so forth. A geologist could doubtless recognize yellow mica, but in the Geological Survey specimens for identification are generally sent to the chemical laboratory. Chemistry is the science that deals especially with the composition of substances. In short, although the professor and many others may not be technically correct in their choice of words, they are fairly within the limits of literary license on one hand, or the necessity of conveying an idea in the only vocabulary they know on the other hand. In dealings with the non-specialist it should be the duty of the specialist to regard the intent not the letter.

U. S. Geological Survey. ROGER C. WELLS.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

THE Ford Motor Co. has purchased the option on the old Red Bird lead-silver property situated near Mackay, in Custer County, Idaho. Active development at lower levels is planned.

Resumption of operations in the Red Jacket section of the Calumet & Hecla property, in Michigan, after the recent fire, may add 750,000 lb. per month to copper output.

The official announcement of Porcupine-Davidson directors shows an average of $2.50 from the latest sampling of the mine by Messrs. Bullen and Kee.

Operation during the winter of the newly completed dredge on Antler Creek, in British Columbia, will be attempted by the Kafue Copper Development Co.

Mining and development in the Eureka-Tintic district in Utah is increasingly active. The Tintic Standard is shipping some 500-oz. silver ore.

The current report of the Burma Corporation, Ltd., on silver-lead operations in Upper Burma is encouraging to the shareholders.

The Hewer Mining Co. has cut 9 ft. of good mill ore at its lead-silver mine at Lakeview, Idaho. The new mill is operating successfully, the last shipment of concentrate netting $3,321.

The Federal Budget provides reductions in appropriations for the Geological Survey and Bureau of Mines. It is hoped that Congress will not make further cuts.

Eureka, Utah, Busier Than for Many Months

Eureka Standard Shaft Passes 900-Ft. Point—Tintic Standard Ships 500-oz. Silver-Lead Ore

Steady production, new development work, and the starting of the final unit of the Chief Consolidated mill, mark increased current activity at Eureka, Utah.

The shaft of the Eureka Standard, controlled by Tintic Standard men, lying between the Tintic Standard and the Iron King mines, is being sunk energetically. The shaft has reached a depth of 900 ft. and sinking is progressing at a good pace. The Tintic Standard recently shipped some ore which it is expected will run about 500 oz. silver to the ton. Although not nearly so rich, this ore recalls the shipment of 60 tons of ore running around 1,000 oz. silver to the ton, at the time when the Pittman Act was drawing to a close. One car at that time brought more than $63,000.

The starting of the volatilization department of the Chief Consolidated reduction plant put the entire installation in operation. Already the flotation department has effected a considerable saving. The volatilization department will make it possible to treat oxidized as well as sulphide ores. As it is proposed to take custom ores, the operation of the mill will be of advantage to the camp in general, as well as to the Chief company.

Three sets of lessees are working at the Centennial-Eureka; and during the week ended Nov. 22, three cars of ore were shipped. One car came from the ore recently opened on the 400, now being developed in the hope of bringing the mine again to important production.

In the Iron King mine, in the eastern part of the district, there has been opened on the 1,340 level, a good showing of milling ore of good grade. The ore is believed to be a continuation of ore opened on the 1,565 level, and followed upward. The new shaft, now down 640 ft., is expected to reach the ore on the 1,340 level in about three months, the present rate of sinking being about 200 ft. per month. In the meantime the new find will be developed. The ore on the 1,565 level carried gold chiefly, but on the 1,340 level there is silver, copper, and lead, in addition to the gold.

Butte Zinc Mines Resume After Five-Day Suspension

FIVE days after the zinc concentrating plant of the Anaconda Copper Mining Co. at Anaconda, Mont., was partly destroyed by fire on Nov. 15, two copper units had been changed over to handle the zinc ores from Butte, thus permitting the zinc mines to resume operations on a normal scale. Hundreds of miners were affected by the order to resume operations at the Butte & Superior and Anaconda mines.

Kafue Dredge, in British Columbia, Completed, Will Start

Freezing Weather May Cause Trouble —First Attempt to Dredge in This Region

The Kafue Copper Development Co.'s dredge on Antler Creek, in the Cariboo district of British Columbia, has been completed and will be put in operation at once. It was planned to have the dredge in operation by Nov. 1, but difficulty was experienced in getting the boilers from the railway to Antler Creek. An effort will be made to operate the dredge through the winter, which seems a bold experiment, as the average temperature in January, the coldest month in the year, is 17 deg. and the minimum 20 deg. below zero.

This is the first dredge to be tried in British Columbia placers, which have yielded $77,000,000 worth of gold by other methods of operation: the deterring influence against dredging operations in the past has been the difficulty of getting heavy machinery into the interior of the province, where the placers are situated. The Pacific Great Eastern Ry., which now runs to Quesnel, has greatly helped matters, but there still is a long and difficult haul from the railway to Antler Creek.

The Kafue company has had a Keystone drill in the field for two years, and the Yukon Gold Co. drilled the ground in 1915. These explorations have demonstrated the existence of several million cubic yards of gravel that will average, it is claimed, around 30c. per yard.

Engels Copper Costs Were 10.99c. in September; Will Be Lower, Says Paxton

Completion of Construction Projects Will Facilitate Operation—Production Increased Above 1,000,000 Lb. Monthly

THE Engels Copper Mining Co., operating in Plumas County, Calif., this year has produced copper for 11.37c. per pound before charging depreciation, according to the general manager, E. E. Paxton. He predicts a 10c. cost for 1925. During the nine months ending Sept. 30, 9,775,743 lb. copper, 110,161.1 oz. silver and 2,259.84 oz. gold were produced. The following figures summarize results:

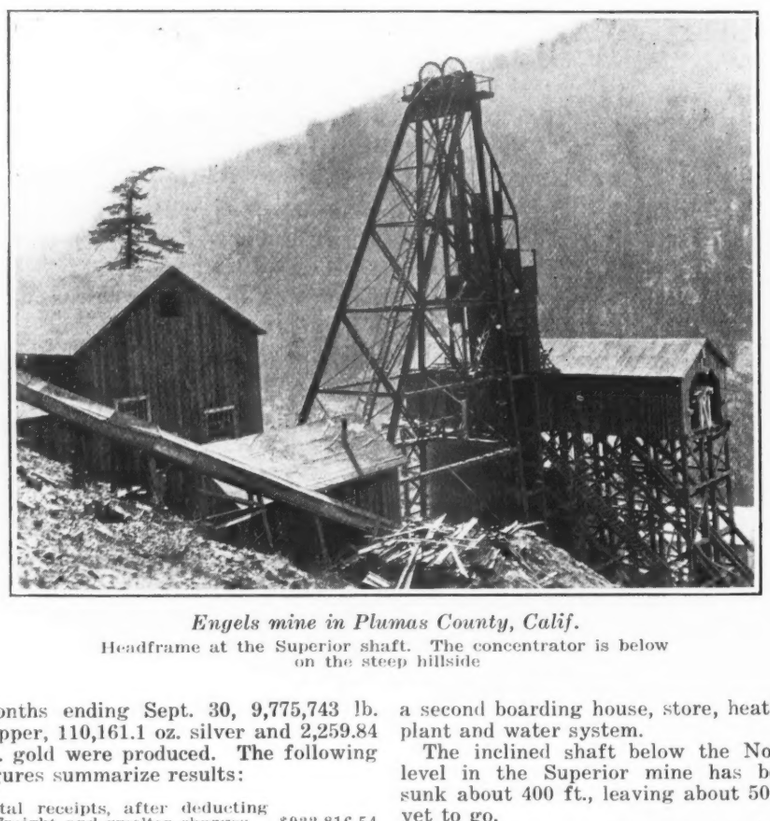
Total receipts, after deducting freight and smelter charges..	$922,816.54
Total operating expenses.....	771,212.52
Operating profit, before depreciation	$151,604.02

The average price received for copper during the nine months' period was 12.84c. compared with the present price of 13¾c. per pound. Net cost of producing, after crediting gold and silver and before depreciation, was 11.37c. per pound for the nine months' period, and 10.99c. for the month of September.

The new haulage adit, 8,727 ft. long, begun in August, 1921, was placed in operation about Oct. 1, and the equipment is working satisfactorily. All the ore from the Engels mine is now dropped through the 500-ft. vertical raise, directly into 6-ton cars, which are transported over the electric railway to the mill, where the cars are dumped by rotary unloader into the mill bins, thus avoiding the hoisting, intermediate crushing and wire-rope tramming employed heretofore.

The work of moving cottages and other buildings from the upper camp and erecting these at the lower camp is nearly completed. In addition, a new boarding house, hospital and dormitory accommodating seventy-six men will be available at an early date.

The electric railway system now used to transport men and supplies to and from the upper mine through the new adit obviates the necessity for the upper camp and the extra cost of maintaining a second boarding house, store, heating plant and water system.



Engels mine in Plumas County, Calif.
Headframe at the Superior shaft. The concentrator is below on the steep hillside

The inclined shaft below the No. 2 level in the Superior mine has been sunk about 400 ft., leaving about 50 ft. yet to go.

During the past five months about 3,300 ft. of development drifts, crosscuts and raises has been finished in the Engels mine and 1,900 ft. in the Superior mine. The opening of the No. 8, 9 and 10 levels in the Engels mine is proceeding rapidly. About 350 ft. of footwall drifts have been driven in ore on the No. 8 level, 360 ft. on the No. 9 and 520 ft. on the No. 10 level. Hanging-wall drifts, crosscuts, raises and chutes preparatory to stoping are in progress. From 15 to 20 machines per shift are drilling on these levels, and the work is at least three months ahead of schedule.

The ore disclosed is satisfactory and compares favorably with the ore from the upper levels of the Engels mine. The stopes in the Superior mine continue in good ore. A new tunnel, called Crosscut A, driven at about 300 ft. above the No. 1 level, has disclosed good ore.

During recent months, pending the opening of the new levels and owing to the low price of copper, ore production was curtailed to about 850 tons per day, producing 1,000,000 lb. copper per month. Under present conditions the ore output has been increased to 1,000 tons per day. If the price of copper advances up to, say, 15c., the output may be still further increased to about 1,200 tons per day.

The construction program will be completed by the end of 1924, leaving practically only mine development expenditure for 1925, which is estimated at from $200,000 to $250,000.

After all surface improvements are paid for, the cash balance at the close of year is estimated at $325,000, with no liability except the outstanding $500,000 of 7 per cent debenture bonds. There are also $185,791 par value of "E" Rights yet outstanding, which probably will be called during the coming year, making total cash resources of $510,000.

After the construction work now under way is completed, it is believed that the total operating cost (before depreciation) should not exceed 10c. per pound of copper, beginning with Jan. 1, 1925.

Belmont-Surf Inlet Ore Reserves Are Dwindling

Passing through Prince Rupert recently, on his way to Philadelphia from an inspection of the company's mine, on Princess Royal Island, British Columbia, Clyde C. Heller, president of the Belmont-Surf Inlet Mines, Ltd., stated that exploration during the last year had failed to add materially to the company's ore reserve, which now was rapidly approaching exhaustion. Exploration was being continued, however, and important new orebodies may be found at any time.

The Belmont-Surf Inlet mine has been one of the big gold producers of British Columbia, having in the last half dozen years yielded, in round numbers, 240,000 oz. of gold, 135,000 oz. of silver, and 4,000,000 lb. of copper from 650,000 tons of ore. The company, which acquired the mine in 1917, is capitalized at $1,200,000. It has disbursed $687,500 in dividends, $500,000 of which was paid out during 1919 and 1920. Last year, the company paid a dividend of $62,500. A large proportion of the ore milled last year was obtained by taking up floors and withdrawing pillars in the upper workings, which have yielded a far better grade of ore than the lower levels of the mine. The mine has been worked to a depth of 1,250 ft.

Small Fire in Ray "Con." Mine

On the morning of Nov. 23 fire was discovered in an obscure section just below the 200 level of the No. 3 shaft of the Ray Consolidated mine, at Ray, Ariz. The fire, which was of unknown origin, caused little property damage, as the flames did not reach the orebody and only slight timber damage was reported.

A crew from the Globe-Miami rescue station, two members of the Bureau of Mines station at Tucson, and the mine rescue car which happened to be at Safford, Ariz., at the time of the outbreak, immediately left for Ray, to assist in fighting the fire. The burning shaft has not been worked by the company recently.

United States S. R. & M. Co. Abandons Effort to Find Meteor

Supposed To Be Buried Near Flagstaff, Ariz.—Should Contain Platinum and Other Rare Metals

It is reported that the mining machinery installed at Coon Mountain (Meteor) near Flagstaff, Ariz., by the U. S. Smelting, Refining & Mining Co., of Boston, in an effort to locate a large iron deposit, is being dismantled.

The drilling operations were conducted in an effort to locate the giant meteor, the falling of which is commonly supposed to have formed the irregularly shaped crater in that locality. According to popular belief this meteor, if it exists, contains platinum and other valuable substances, which would prove extremely profitable. The broken limestone formation made drilling slow and costly. This work has been under way for approximately three years. Dismantling the machinery is in charge of Joe Onetta, superintendent of the company's Gold Roads mine.

Scientists are not agreed about the meteor. Some insist that it was a meteor that made the crater and that it is still buried deep beneath. Others insist that the crater was made by a blow-out of steam or gas. Much has been written about Meteor Mountain, which really is not a mountain at all, but a small hill, with a half-mile wide crater. Substance was given the meteor theory by the finding of several carloads of meteoric fragments close to the mountain. These were believed to be pieces of the meteor which dug its grave there.

Park City Breaks Tonnage Record in Ore Shipments

Shipments of ore from Utah mining camps during the week ended Nov. 22 were:

Park City—7,064 tons of ore and concentrates, this being the largest week's output in the history of the camp. During the preceding week 5,833 tons was shipped. Shippers were: Park-Utah, 2,700 tons; Silver King Coalition, 1,765 tons; Park City Mining & Smelting, 1,513; Ontario, 586 tons; and Keystone, 450.

Eureka—Gross shipments, 161 cars, compared with 142 cars the week preceding. Shippers were: Chief Consolidated, 55 cars; Tintic Standard, 49; Tintic Milling, 14; Bingham Mines, 14; Iron Blossom, 9; Mammoth, 9; Dragon, 8; Centennial-Eureka, 3; Plutus, 2; Colorado, 1; Tintic Drain Tunnel, 1.

Loan Fund Established at M. C. M.

The "M. C. M. Lode," the student periodical of the Michigan College of Mines, has presented the institution with $125 to serve as a nucleus for a scholarship fund, from which loans can be made to students who are in need of financial assistance. Any student who has successfully completed one year's work may borrow up to $150, giving in return his note at the rate of 6 per cent, payable after graduation. E. D. McNeil, of Virginia, Minn., was the first to add to the fund. He donated $100.

Columbus-Rexall Ships Copper-Silver Ore from Alta

The Columbus-Rexall mine, at Alta, Utah, has opened new ore 180 ft. below the tunnel level. The ore is copper-silver, and is thought to be the downward extension of a body, which on higher levels produced well. The new ore has been followed 100 ft. on its strike, and 40 ft. on its dip, and the width is from 5 to 10 ft. Assays show 10 to 15 per cent copper and 30 to 40 oz. in silver. During the week ended Nov. 22, shipments were made at the rate of about fifty tons a day. It is hoped to increase this with better haulage.

Boulder County, Colo., Silver Mines Will Be Reopened

Fairview Mining Co. Will Develop Group of Properties — 100-Ton Flotation Plant To Start

Allen L. Burris, formerly with the El Paso mine, at Cripple Creek, Colo., with Eastern associates, has taken over the Boulder County mines, at Cardinal, and has begun extensive operations under the name of the Fairview Mining Co.

In connection with the new holdings the company has acquired adjoining properties which are undeveloped, but long believed to contain an extension of the rich silver oreshoots which have made the Boulder County mine famous.

It is the purpose of the new company to start immediate exploration and development of the new property, and at the same time to remodel the 100-ton milling and flotation plant and reopen the old workings, which it is believed will maintain a sufficient output to keep the plant operating at capacity.

The mines are operated from the old Boulder County tunnel, which was projected for this purpose, and, when extended, will cut under the old silver mines at Caribou.

Ford Motor Company Buys Bond and Lease on Red Bird Lead Mine, in Idaho

THE bond and lease on the Red Bird silver-lead mine, situated 90 miles from Mackay, Idaho, under which R. N. Bell has operated for several years, has been purchased by the Ford Motor Co. The Ford interests will continue to operate the mine and will add a great deal of equipment. It is hoped within the two years that the bond has to run that a large orebody will be developed.

The property is known as the Bruno group. It is situated in the Bay Horse district and has a record of having produced more than $1,000,000. Two tunnels and a vertical shaft 700 ft. deep comprise the opening to date. W. H. Griswold, western sales manager for the Ford company, at Salt Lake City, is arranging for delivering some of the new equipment, which will include trucks, tractors and trailers for transportation; Diesel engines, compressor, machine drills and diamond drills. The actual development operations will be directed by M. E. Wilmot, general manager of the Ford mines in Missouri, under the supervision of John Reigart, of Iron Mountain, Mich., who is in general charge of Ford mining operations.

About forty men will be put to work at once to conduct exploration, particularly in the lower horizons below the permanent water level.

The General Motors Co. is exploring the Livingston group on Railroad Ridge, a few miles from the Red Bird property. The company is installing hydro-electric power, tramways, and a concentrator and is constructing 60 miles of modern highway. It is said that $400,000 has been spent by the company to date.

The district in which these companies are operating has long been known as a rich mineral region, but only large capital is able to undertake exploitation, on account of the distance from rail transportation, approximately 60 miles.

Drum Lummon Has Much Plant But Little Ore

Drum Lummon Mines, Ltd., of British Columbia, has gone into liquidation. The company purchased the Drum Lummon mine on Douglas Channel, Hartley Bay, some two to three years ago, and proceeded to equip the property in a thoroughly businesslike way, but unfortunately did not use the same business acumen with regard to the underground development. A pile dock with substantial warehouse and 1,000 ft. approach was constructed. A 2,100 ft. jib-back aërial tramway was erected and a 3,600-ft. railway, connecting the bunkers at the foot of the tramway with the wharf, was built.

A 120-hp. Diesel engine and a 500-cu.ft. compressor were installed. This work was completed in May, 1923, when the New York backers of the enterprise withdrew their support, and the property has been idle since. The ore occurs as chalcopyrite, chalcocite, and bornite in disseminated grains around the borders of and in the quartz and feldspar of what appears to be a pegmatite dike. In spots the ore has high gold content.

Will Ship from Lucky Jim, in British Columbia

Plans are under way to ship ore to the Trail smelter from the Lucky Jim mine, in British Columbia, according to A. G. Larson, manager of the property. Silver-lead ore recently was opened on the No. 5 level, resulting from work recently started after the mine had lain idle for several years. The mine in its early history was a prominent zinc producer, but recent strikes have proven lead-silver ore.

Hewer Mining Co. Has 9 Ft. of Good Ore in Idaho

Idaho Silver-Lead Property Ships Concentrate Netting $3,321—Development Continues

The orebody being followed by the Hewer Mining Co. at its property near Lakeview, Idaho, on Pend Oreille Lake, is 9 ft. wide at the face. The body has a quartz-siderite gangue, the drift is encountering conditions typical of the Coeur d'Alene region and the galena and silver contents are increasing, according to a report from R. H. Hewer, superintendent. The vein has been followed by drift for 1,060 ft., of which 750 ft. was in ore. Dan M. Drumheller, of Spokane, is general manager.

The maximum depth attained in the first 700 ft. of adit was 300 ft. A depth of 1,400 ft. will be attained in an advance of 1,600 feet by a new drift which is entering a mountain to the southward through which the vein has been traced at the surface.

The last two carloads of concentrate shipped netted the company $3,321 after the payment of freight, smelting, and royalty charges. Snow sheds and houses have been completed, assuring uninterrupted operations. Ample water for milling purposes has been provided by 4 ft. of snow, which fell before the arrival of cold weather.

At the Mayflower-Old Colony property, no developments are expected for several weeks. The crosscut from the 1,700 level toward the St. Louis amygdaloid is in barren ground and probably will continue in trap for the next 400 ft. until the vein is reached. Diamond-drill cores indicate that the St. Louis lode in this vicinity is well mineralized.

Hewer Concentrator at Lakeview, Idaho

Resumption Expected by Seneca, in Michigan Copper Country

The Seneca mine, in the Michigan copper district, is to be reopened, according to reports. Both the Seneca and Gratiot No. 2 shafts have been kept free of water since the shutdown on April 26 last. Seneca is well opened, but how quickly it can get into production will depend on its ability to obtain an adequate underground force. Seneca was employing 350 men at the time of the shutdown, and production was 1,100 tons daily. Most of the former employees now are employed at other properties in the district. When operations ceased at Seneca, rock was being stamped in the Ahmeek mill, and it is believed that this arrangement will continue in force. The mineral will be smelted in the Calumet & Hecla smelter.

Anaconda Offers $95,000 in Suit Inherited From Davis-Daly

Compromise of the $470,000 action filed against the Davis-Daly company, of Butte, now absorbed by the Anaconda Copper Mining Co., by Mrs. Rose Marie Bridge, as executrix of the estate of Thomas F. Hickey, has been authorized on petition of the executrix by Judge J. J. Lynch. The total sum offered by the Anaconda company in the settlement of the action is $95,000, of which $23,750 goes to the Hickey estate.

The dispute involved ores extracted from above the 100 level of the Lizzie lode claim by the Davis-Daly company. The Hickey estate owns a one-fourth interest in the property involved in the present suit.

California Miners Plan to Prevent "High-grading"

The California Metal & Mineral Producers' Association has appointed a committee to consider plans providing for additional legislation and regulation designed to prevent the sale of stolen ore. A preliminary report recently issued indicates that the co-operation of Mint officials and the smelting companies may be expected. The Mint, it is reported, has adopted a detailed bullion deposit statement in accordance with suggestions submitted at a meeting of the committee in San Francisco in August.

Hereafter, Californian smelting and refining companies will be required to follow these regulations, the enforcement of which is expected to aid mine operators in tracing those who sell stolen ore. The association will probably take steps in support of legislation providing for the licensing of ore and bullion buyers under provisions similar to those in effect in Colorado.

Bullen-Kee Sampling of Porcupine-Davidson Shows $2.50

May Be Better 2,000 Ft. Lower, but Sees No Justification for Expenditure Involved

H. H. Bridgewater, managing director of Porcupine-Davidson Gold Mines, Ltd., has issued a circular to shareholders containing the reports of R. H. Bullen and H. R. Kee, who examined the property and reported in October last. These reports stated that the average ore indicated by the assays of these engineers' sampling of the mine was unpayable, and does not seem to confirm previous reports of Messrs. Fielding, Loring, and Bent upon which the property was originally sold. In closing his report R. H. Bullen states that he cannot say whether 2,000 ft. deeper there will not be a change for the better, but there is nothing he can see to warrant the necessary expenditure to reach a depth sufficient to prove that theory.

The following extracts are given from Mr. Bullen's report:

"No geologist can make a positive statement to the effect that gold in payabe quantities cannot occur in the formation in which the Davidson mine is being worked without the close proximity to porphyry, but the fact remains that the paying mines of Porcupine and the Kirkland Lake district have porphyry near or alongside the vein series, which seems to have influenced the deposition of gold in some way. In this connection the thirtieth annual report of the Ontario Department of Mines shows that in the opinion of the government geologists, the geological conditions at the Davidson mine differ from those of the Hollinger and McIntyre"

The summary of the average values per ton obtained by Mr. Bullen during the recent examination at the different levels give a general average value of $2.50, and a width of 8.03 ft.

Work Resumed in Calistoga District, Near San Francisco

Messrs. Baverstock and Payne have financed development work on the old Palisades gold-silver mine, which they have under bond, near Calistoga, Calif. The mill-tunnel level is almost cleared out, showing a vein ranging from 5 to 15 ft. and a shoot with a length of more than 700 ft. So far no attempt has been made to unwater below the mill tunnel level. The old stopes show a large amount of ore that it is believed can be profitably milled by modern methods of treatment. A mill is planned. The mine has had a production of about $450,000 from the better-grade ores.

The Silverado mine, in the same belt, but higher up on the slope of Mount St. Helena, has been bonded by C. E. Miller, of Tonopah and San Francisco, who has begun operations. A large block of low-grade ore was also left in this property after a production of about $200,000 had been made.

The district is within 40 miles by paved highways of the Selby smelter, on San Francisco Bay.

Gross-Proceeds Mine Tax Approved at Montana Election

Initiative Measure Repeals Old Net Profits Tax—Agitation Has Been Harmful to Development

Gross proceeds of mines in Montana, when they exceed $100,000, are to be taxed on a sliding scale from one-fourth of 1 per cent to 1 per cent, according to the decision of the voters at the initiative election in November. Section 4 of the "License Tax" measure, which deals with the amount of the tax reads as follows:

"The Annual License Tax to be paid by such person engaged in or carrying on the business of working or operating any mine or mining property in this state from which gold, silver, copper, lead, or any other metal or metals, precious or semi-precious gems or stones are produced, shall be $1, together with an additional sum or amount equal to an amount computed on the gross value of the product which may have been derived by such person from such business, work or operation within the state during the calendar year immediately preceding, at the following rates: One-fourth of 1 per cent of the amount by which such gross value of product exceeds $100,000 and does not exceed $250,000; one-half of 1 per cent of the amount by which such gross value of product exceeds $250,000 and does not exceed $400,000; three-fourths of 1 per cent of the amount by which the gross value of the product exceeds $400,000 and does not exceed $500.000 and 1 per cent of the amount by which the gross value of the product exceeds $500,000."

The gross value of the product is determined by taking the gross yield of metals at the reduction works and applying the price quoted at New York.

In 1921 the Legislature passed a "mines license tax" on the basis of $1 and a sum amounting to 1½ per cent of the net proceeds. In 1923 a bill to change the "net proceeds" license to one based on "gross proceeds" was defeated through the efforts of the mining companies.

The measure just passed is practically the same as that introduced in the Legislature in 1923, the exception being in the exemption of the first $100,000 of gross proceeds from other than the $1 license tax. Preliminary drafts of the measure were based on a sliding scale with the maximum at 2 per cent, but the authors were induced to retain the scale on the basis of the bill introduced during the last session of the Legislature. Many see in the action of the voters of Montana the removal of "tax agitation" which has been a stock argument against investment in the mineral resources of the state. Never, in fact, a menace, the agitation has been used to the detriment of the industry. Taxation on personal property, improvements, equipment, or other forms is in no wise affected by the new law.

Under the constitutional provision the only tax yielding any return to the state from the natural mineral resources was that providing for payment on an assessed valuation of the "price paid the United States therefor," or, at the value of $5 per acre for quartz claims and $2.50 per acre for placer claims. All claims are thus subject to the same tax regardless of the value of the mines which had been developed in them.

Chloride Queen Is Building 50-Ton Concentrator in Washington

Milling ore has been followed for 30 ft. on the lowest level of the Chloride Queen mine, situated 12 miles north of Colville, Wash., according to Dave E. Zent, general manager. The new strike is 850 ft. from the portal of the lowest tunnel and about 400 ft. below the surface. The intermediate levels all expose milling ore in large quantity, and this last strike is indicative that the orebodies will continue to substantial depth.

A concentrator of 50-ton daily capacity is under construction and will soon be completed. The mine has been undergoing development for several years. The ore is lead-silver.

Calumet & Hecla Resumes Operation in Red Jacket Ground

Idle Since Fire of Sept. 16—May Add 750,000 Lb. to Monthly Copper Production

Calumet & Hecla Consolidated, in the Michigan copper district, has resumed operations in the Red Jacket slope shafts, No. 5 and No. 2, Calumet conglomerate branch, which have been closed since Sept. 16, because of a fire in No. 4 shaft. Only No. 4 is now inactive, and it will be some time before this shaft is operated, owing to the fire damage.

Repair work is under way in No. 4, but the full extent of the damage has not yet been determined. The fire burned from the 41st to the 78th levels, and considerable timbering will be necessary in the shaft and stopes and drifts. The Calumet shafts in operation should add approximately 750,000 lb. of copper per month to production.

The Red Jacket slope shaft and No. 5 are mining in virgin ground; No. 2 is taking out rock from the backs of old stopes in the upper levels.

All underground operations in Ahmeek and conglomerate branches of Calumet & Hecla Consolidated are on six-day a week schedule. This also holds true of surface work at Ahmeek, but at the conglomerate shafts all surface work for the present is confined to five days per week.

Jury Refuses Damages to C. & A. Employee Who Broke Leg

The jury in the case of Edward P. Johnson, employee of the Calumet & Arizona Mining Co., against the company, returned a verdict for the defendant at the trial in Tombstone, Ariz. Johnson had sued the Calumet & Arizona company for $25,000 for injuries received in the Briggs mine, at Lowell, resulting in the fracture of his right leg. Testimony in the case showed that Johnson had refused settlement of the case offered by officials of the company.

Near the Chloride Queen mine in Washington

Construction of a 50-ton concentrator is under way. The company is sawing its own timber and lumber in the plant shown here.

Underwriters Buys Waxahachie Property Near Century, Okla.

The Underwriters Land Co. has purchased the Waxahachie mill and lease, located south of its No. 4 property, near Century, Okla., in the Joplin-Miami district.

The company has had an option on the property for some months and made the purchase after a careful investigation. Acquisition of the lease gives the Underwriters 200 acres in one block in this locality, the other properties being known as the Underwriters No. 4, and the No. 6. The latter property, known as the McCullagh tract, was taken over recently and a new mill is now nearing construction on it, decided upon after extensive drilling. Two shafts have been completed on this tract.

Shaft sinking has been temporarily suspended on the Stebbins land, north of the Lucky Jew, in the northwestern portion of the Kansas section of the district, by the Underwriters company, but will be continued later.

Mohawk Plans to Hoist 2,600 Tons of Ore Daily

Mohawk, in the Michigan copper district, is hoisting 2,200 to 2,300 tons of rock per day from three Mohawk shafts, and as soon as the underground force is fully recruited production will be brought up to 2,600 or the capacity of the four heads in the Mohawk mill. The labor situation continues satisfactory and each week shows a net gain. Meanwhile, one head is in operation on Wolverine rock in the Wolverine mill. It is not likely Mohawk will resume work in the Pewabic lode in lands to the west of Wolverine until next spring.

Mountain Copper Resumes Pyrite Shipments from Hornet Mine

The crushing and conveying plant of the Mountain Copper Co., Ltd., at the Hornet mine, near Redding, Calif., which was destroyed by fire early in October, has been repaired; and shipments of pyrite are being made to chemical plants on San Francisco Bay.

The company was at one time among the world's largest producers of copper, the continuance of profitable operation in recent years having been due to the utilization of the immense reserve of pyrite ore in the manufacture of a basic chemical commodity, sulphuric acid.

Rio Plata Mines and Mills for $6.50 Per Ton

Regular shipments are being made from the Rio Plata mine, in the Arteaga district in Chihuahua, Mexico, by H. W. Edmondson, lessee. They include high-grade ore, concentrate and bullion. Located 100 miles from the railroad in the heart of the Sierras, costs are being held down to $6.50 per ton by using cheap water power and by economical organization of mine and cyanide plant operations. Local and state authorities offer encouragement to continued operation in these outlying districts.

News from Washington

By PAUL WOOTON
Special Correspondent

Budget Cuts Bureau and Survey Appropriations Slightly for Coming Year

Hope Is that Congress Will Not Do Customary Further Paring—Amounts, $1,876,560 and $1,654,595 Respectively

THE president and the director of the budget have approved proposed appropriations for the next fiscal year of $1,876,560 for the Bureau of Mines and $1,654,595 for the Geological Survey. These amounts compare with $1,900,468 and $1,706,482, respectively, the sums which were appropriated for the work of the current fiscal year. If Congress insists on paring the budget in the same proportion as has been its custom, it will impose a heavy curtailment of the work done by these two agencies. It is believed, however, that Congress will take into account the fact that very drastic reductions have been made in the amounts originally requested by the heads of the separate executive agencies, and the prospects favor the actual appropriation of approximately the amounts carried in the budget.

The budget figure for mineral mining investigations, to be conducted by the Bureau of Mines, is $117,800. This is $10,000 less than the amount appropriated at the last session. This appropriation is to be expended "for inquiries and scientific and technologic investigations concerning the mining, preparation, treatment and utilization of ores and mineral substances, other than fuels, with a view to improving health conditions and increasing safety, efficiency, economic development, and conserving resources through the prevention of waste in the mining, quarrying, metallurgical, and other mineral industries; to inquire into the economic conditions affecting these industries."

It is proposed to expend the amount as follows: personal services $98,800; supplies and materials, $5,745; communication service, $500; travel expense, $8,405; equipment, $3,250; rent, $500; freight expense, $600. If the full amount asked is granted this phase of the Bureau's work would have at its disposal $12,500 less than during the last fiscal year. This reduction will be made possible by reducing the field force from thirty-eight to thirty-four; by reducing the staff in the Washington office from thirteen to nine; and by reducing the travel expense. The reduction also involves the elimination of the services of one engineer and makes necessary to dispense with part-time service of a senior engineer and a senior scientist.

Other items making up the Bureau of Mines budget are: investigating mine accidents, $400,000; general expense, $86,000; mining investigations in Alaska, $33,000; operating mine rescue cars and stations, $281,840; testing fuel, $150,000; oil, gas, and oil shale investigations and leasing work, $456,000; enforcement of mineral leases, $86,920; mining experiment stations, $200,000; care of buildings and grounds at Pittsburgh, $65,000.

Items making up the Geological Survey budget are: preparation of reports on the mineral resources of the United States, $123,000; geologic maps, $105,000; examination and classification of lands, $265,695; gaging streams, $165,000; investigations of the mineral resources of Alaska, $72,000; chemical and physical research relating to geology, $40,000; geologic surveys, in various parts of the United States, $326,140; topographic surveys, $485,000; director's office, $54,760; preparation of illustrations, $18,000.

Sponge Iron Method of Making Steel "Metallurgically Feasible"

So Says Acting Director of Bureau—Composition of Iron or Steel Can Be Regulated

In view of experiments conducted at the Seattle Station of the U. S. Bureau of Mines, Dorsey A. Lyon, acting director, declares that there no longer can be doubt that the problem of producing iron and steel from Northwestern ores, using sponge iron as an intermediate, has progressed to the point where it can be pronounced metallurgically feasible.

The process likewise promises to become practicable in other localities. The early practice was to melt the sponge iron in a continuously operating pit furnace where the metal is partly refined and separated from the gangue. The molten metal then was transferred to an ordinary refining furnace for finishing. Later experiments, however, have proved it to be practicable to carry out the whole operation in a single furnace of standard type. Any composition of steel or cast iron can be produced with equal facility. Sound, flawless, mild steel containing as low as 0.01 per cent sulphur and soft gray iron with transverse strength as high as 5,600 lb. have been produced. It is believed that sponge iron will be used extensively as a foundry raw material when the cost of steel and iron scrap is high enough to allow for slightly higher costs of melting and refining sponge iron.

"Synthetic" Sillimanite Good Refractory

Experiments at the Seattle station of the U. S. Bureau of Mines have established, it is declared, that "artificial sillimanite" is an excellent refractory material. It is necessary, however, to prevent an excess of silica, and lime in excess of 1.5 per cent causes a serious reduction in the melting point. Iron oxide and magnesia likewise are said to affect it adversely.

London Letter

By W. A. Doman
Special Correspondent

Burma Corporation Report Confirms Recent Optimism

Indian Workers Tried Underground for First Time—Labor Efficiency Maintained—Metallurgy Better

London, Nov. 18.—Increased dividends paid by the Burma Corporation during the year raised hopes that the directors' report would prove satisfactory, and these hopes have been realized. In every department an improvement is shown, this being particularly noticeable as regards labor, extraction, and the railway. At one time labor proved a difficulty, and it is interesting to note that efficiency has been maintained despite the large increase in the number of shifts worked, practically all of which is represented by the employment of absolutely unskilled recruits. The labor force has, in fact, undergone a great change in nationalities, and whereas previously little Indian labor was employed underground, Chinese and Indian races are now employed in nearly equal proportions.

The experimental zinc flotation plant is being extended. At the beginning of the period the recovery of zinc was about 12 per cent; at the end of the period it had risen to 22 per cent, and when alterations are completed it is expected to reach 40 per cent. Of the total tonnage treated, the tailing products were 7.96 per cent silver, 6.91 per cent lead, and 26.36 per cent zinc, the total accounted for being 98.28 per cent silver, 98.65 per cent lead, and 98.57 per cent zinc. The grade of ore was slightly lower than for the previous twelve months, with the result that its measurement increased from 10.29 to 10.43 cu.ft. per ton, or an increase of 1 per cent in cubic content for an equal tonnage. The mine ore reserves aggregate 4,499,866 tons, assaying 22.5 per cent silver, 25.2 per cent lead, 16.6 per cent zinc, and 1.3 per cent copper. Copper ore is not shown as a separate tonnage, owing to the impossibility of making reliable estimates, following the sudden changes from lead to copper ore and vice versa that have been found to take place since the stoping of copper ore has been started. The Shan lode has disclosed high-grade copper content, going as high as 18.9 per cent, but the lode has proved to be much disturbed and difficult to trace from level to level.

In a recent communication I mentioned a rumor that the Ropp Tin (Nigeria) had proved its rich area, and that the remaining ground was of less value. The directors have evidently interpreted the story as an attack upon the shares, and have denied its accuracy. Owing to the rise in tin, the company has paid already, for the current working year, interim dividends amounting to 60 per cent.

Earlier in the year I mentioned the signing of a provisional agreement between Vivian & Sons, Ltd., Williams, Foster & Co., and Pascoe, Grenfell & Sons, Ltd., for the formation of a new company to carry on the amalgamated businesses. The new company is now registered as British Copper Manufacturers, Ltd., and will control the works in the Swansea district producing copper, yellow metal, spelter, lead, and acids.

The total capital is £1,500,000, of which £1,000,000 is in ordinary shares of £1 each, and the balance 6 per cent cumulative preference shares also of £1 each. Of these shares 800,000 ordinary and 400,000 preference are being issued. At present the new company will remain private, but the vendor companies will invite public subscription for a portion of their share holding in the new company, early in the new year. Central Mining is represented on the board by R. Sothern Holland, the chairman, and F. Heim. As the main works of the two companies adjoin at Swansea, a prosperous career is expected.

An official cable dispatch from the Cam & Motor Mine (Rhodesia) reports a new rich strike on the Petrol lode The North drive from the Motor lode at No. 8 level toward the Petrol lode has struck the Petrol reef, and for 15 ft. driving the average is £8 14s. per ton for a width of 70 in. The importance of the strike lies in the fact that this level is 390 ft. below the No. 5 level at the Petrol mine.

Silver Production Increases in Patagonia Mines, in Arizona

With the better price for silver, activity is increasing in the Patagonia mining district in Arizona. The Duquesne mine, under lease to Little & Bell, of Warren, Ariz., has begun shipping ore. One car has already left for the smelter, and it is expected that the output will approximate two carloads a week in the near future. The B'ue Nose group, which is being operated by Los Angeles interests, and which is an old-time producer, with a record of about $300,000 to its credit, taken from deposits carrying 1,000 oz. of silver to the ton, is reported to have 20,000 tons of medium grade lead-silver ore blocked out and ready for stoping. The American and Hardshell mines, near Harshaw, the Mowry mine, and several others are also shipping. The Mowry silver-lead ore is reported by the management to be unusually good.

Seven More Awards

Settlement of seven war mineral relief claims has been announced by the commission. The total of the awards is $11,176, the biggest being made to the Summerfield Tungsten Co. of Mina, Nev. An award of $3,265 was also authorized to Judson Thomas, of Nederland, Colo. The awards follow:

Arizona

A. L. Pellegrin & Son, Tucson	$1,401.45

California

Thomas & Granger, Nevada City	$939.25
Frank R. Bowers, Forest Hill	739.20
Benter, Van Ness & Lindsay, Atascadero	302.64

Colorado

Judson Thomas, Nederland	$3,265.26

Nevada

Summerfield Tungsten Co., Mina	$3,302.43

Tennessee

Reynolds & McQueen, Butler	$1,225.91

Melbourne Letter

By Peter B. Tait
Special Correspondent

Arbitration Court Grants Increase in Mine Wages

Hopes To Preserve Industry in Victoria and Tasmania—Labor Union Presses Claims

Melbourne, Oct. 27—What is considered to be an important judgment affecting the Victorian and Tasmanian mining industry was recently delivered in the Commonwealth Arbitration Court by Deputy President Webb. His Honor pointed out that the case dealt with the industry of metalliferous smelting, reducing and refining of ores in Victoria and Tasmania. Few matters had caused him greater anxiety. This was an industry that could not be carried on unless the products of the mine exceeded in value the sum it cost to produce them. No increase in the cost of production could be passed on to the consumer. The industry had to show a profit or cease to exist, but its condition was such that owners of mines that had been carried on for many years had been compelled permanently to close them down and abandon the undertakings. That was not because of any change in the character of the mine, but because the products could not profitably be sold in competition with those of mines in other parts of the world. Mining was a decadent industry in Victoria and Tasmania, and was carried on only under great difficulty in present conditions. The employees asked for large increases in wages and important alterations in the conditions of employment, and the owners replied that if those demands were granted there would be an end of the industry.

The attitude of the claimant organization had been definitely stated by Mr. Jude. He said the union wanted the increases, whatever the consequences to the industry might be. If it were destroyed, the men must find work in other avenues of life. The union contended that men ought not to be required to work at the present rates, and it took the full responsibility of pressing its demand. That, however, was not the attitude of the individual miners. None of them had expressed a desire that the industry should be destroyed, and some indicated that they would regard the closing of the mines as a calamity.

The claimant organization had asked that in all country districts the basic wage should be fixed on the "five towns" rate. In Victoria that would be equal to £4 0s. 6d. a week for the present quarter. This, with the 3s. usually added, would total £4 3s. 6d. a week. The decree prescribed the following rates as basic:

Ballarat, £3 13s. 9d.; Bendigo, £3 13s. 0d.; Gippsland, £3 18s. 6d.; all other parts of Victoria, £3 14s. 0d. Queenstown (including Gormanston and Linda), £3 15s. 6d.; and Zeehan, Rosebery, Williamsford, Tullah, Waratah, Magnet, and other West Coast mining districts in Tasmania, £3 15s. 6d. The court prescribed a long list of marginal rates varying from 1s. to 18s. a week.

Societies, Addresses, and Reports

Colorado Mining Men Will Meet in January

Report of Committee of Inquiry Appointed Last Year Awaited With Interest—Entertainment for Prospectors Planned

The annual joint convention of the Colorado Metal Mining Association and the Colorado Chapter of the American Mining Congress will be held in Denver Jan. 20, 21, and 22, 1925. The organization embraces the metal, oil, and coal interests of the state, but its activities in the past have been chiefly confined to the problems of the metal miner. The discovery of oil in commercial quantities in various parts of the state during the past year has brought the industry to the front, and the oil man and his problems will have a prominent place on the program in 1925.

An outstanding feature of the meeting will be the annual "sow-belly" dinner, at which will gather the old-timers and prospectors from all over the state to recall the glory of bonanza days and to repeat the marvelous story of adventure dating back to the hectic youth of Leadville, Creede, and Cripple Creek. Vying with the old-timer will be the modern prospector, who has been much in evidence in the mountain districts of Colorado during the last year and who will bring to the meeting proof that his efforts were not in vain and that rich reward awaits intelligent search for wealth in Colorado hills.

Arrangements for the exhibition of ore from new discoveries will be made and during the meeting an effort will be made to arrange facilities for the prospector to get in touch with capital to develop his discovery.

Among the questions to be considered at the annual meeting will be the report of the inquiry committee, which will submit findings in accordance with a resolution adopted at the last annual meeting, which provided for a committee of five "to inquire into and recommend measures which will tend to the rehabilitation of the mining industry in Colorado." A strong committee was appointed, and its report is awaited with interest by mining men. Proposed legislation affecting the Industrial Commission, taxation, conservation of oil resources and regulation of drilling, appropriations for research work at the Colorado School of Mines, and the continuance of an agreement with the U. S. Geological Survey on a fifty-fifty basis to facilitate the completion of a topographical and geological survey of the state will be considered and a definite policy of the organization regarding the measures will be adopted at the meeting.

Southern Exposition Coming

Progress is being made in the preparations for the Southern Exposition that is to be held in the Grand Central Palace, New York, Jan. 19 to 31 next. Colonel Joseph Hyde Pratt, of Asheville, N. C., is vice-president of the exposition.

Oklahoma Commissioner Sets Date for Safety Hearing

Claude Connally, labor commissioner of Oklahoma, has set Dec. 16, at the State Capitol in Oklahoma City, as the time and place for a general and final hearing on his proposed rules and regulations to promote safety in the petroleum industry. The hearing will be open to everyone interested in the various branches of the oil business; and all who have anything to say about the proposed rules have been urged to attend and express themselves; this hearing, it is said, is intended to afford everyone his day in court so far as the commissioner is concerned.

The commissioner, in June of this year, drew up a tentative set of safety orders and submitted them to oil operators, including a committee of the Mid-Continent Oil & Gas Association, for criticism and suggested revision. This initial set of orders was printed in full in the association bulletin of June 14. After receiving the criticisms of those to whom he submitted the proposed orders, the commissioner revised the data and has now determined upon the subjoined revised tentative orders as the basis for the hearing that will be held on Dec. 16.

B. C. Chamber of Mines Active

The British Columbia Chamber of Mines, at Vancouver, B. C., is making arrangements for the opening of its winter activity. Night classes in mining are being started under its auspices. A series of lectures on mining conditions in the province and the future possibilities of the industry is to be delivered by the government mining engineers and others qualified to speak on the subjects to be covered.

Taylor Society Meets

A meeting of the Taylor Society was held in the Engineering Societies Building, New York, on Dec. 4, 5, and 6. The society is an international organization for promoting the science and art of administration and management. Its meetings are open to anyone interested. At the meeting just held papers were presented on various phases of management.

Montana Engineers Hold Monthly Meeting

A review of mining conditions in New Zealand and the story of asbestos were features of the last monthly meeting of the Montana Society of Engineers, held in Butte. Malcolm Fleming, mining engineer, who was present as a guest of George W. Craven, president of the School of Mines, talked on the mineral wealth of New Zealand, where he had been engaged in mining for several years. M. H. Giedel, of Butte, speaking on asbestos, said that, although the mineral was found in various parts of the state, no commercial deposit had as yet been discovered. His talk was illustrated with motion pictures.

Power Equipment Displayed at National Show in New York

Lectures by Prominent Men and Motion Picture Program Compete With Machinery Exhibits for Attention

The third national Exposition of Power and Mechanical Engineering opened in the Grand Central Palace, New York City, on Dec. 1, and continued for the entire week. This exhibition is intended to function as a clearing house of information about recent developments in power and mechanical engineering. Three floors were devoted to exhibits of many kinds of power appliances, equipment, and specialties. The displays included boilers, stokers, superheaters, economizers, preheaters, pumps, condensers, valves, and accessories of all kinds. The exhibits were of interest to all industries using heat or power in any form, or which have problems in mechanical engineering.

One of the features of the show was a series of lectures given by prominent men. The subjects selected for these lectures were: "The Boiler Room," "Steam Prime Rollers," "Oil and Gas Engines," Hydro-electric Power Plant Equipment," "Materials Handling," "Modern Machine Tool Developments," "Mechanical Power Transmission," "Mechanical Refrigeration," and "Heating and Ventilation." These lectures were arranged so as not to conflict with the technical sessions of the annual meeting of the American Society of Mechanical Engineers, which were held in the Engineering Societies Building Dec. 1 to Dec. 4.

Other features of the exhibition were an elaborate program of motion-picture films of general engineering and industrial interest, and educational exhibits showing development of various forms of mechanical engineering equipment. One of the exhibits was intended to illustrate the historical development of machine tools.

The exposition was administered by the International Exposition Co., the managers of which are Fred W. Payne and Charles F. Roth. The management was assisted by an advisory board composed of consulting engineers and representatives of the A.S.M.E., and other technical societies.

"Considering the exposition as a whole," said one engineer, "the exhibits may all be grouped into three general classes: first, those which are new developments, comprising new inventions, new processes, and new ideas; second, those which are improvements on old or tried principles and accepted theories; and third, those which might be grouped under the head of engineering staples.

"The spirit of progress is the inherent characteristic of this exposition, and it is proper that the new ideas which have been developed form its real nucleus. If they are properly exhibited, they are certain to be of interest to the profession and to the layman, and certainly there is no finer way to introduce a new idea than to have it well exhibited at one of these expositions. If it is of value, it will become known in a comparatively short time."

Men You Should Know About

F. L. Bosqui, metallurgist and mining engineer, is in Europe.

G. M. Colvocoresses, of Humboldt, Ariz., was recently in San Francisco.

Frank D. Pagliuchi, consulting mining engineer, has left for Caracas, Venezuela.

Fred Hellmann, mining engineer, now has offices at 149 Broadway, New York City.

Wallace Nesbitt, of Toronto, has been appointed a director of the Dome Mines, of Porcupine, Ont.

A. J. Kelch, of Usk, north-central British Columbia, is in San Francisco. He will remain in California for the winter.

L. H. Biggar has joined the staff of the Hardinge Company as consulting engineer on thickening and classification.

Maurice W. Summerhayes has been appointed consulting engineer of the Tough Oakes-Burnside Co., of Kirkland Lake, Ont.

Frank W. Klett, of Toledo, Ohio, has made an examination of the Goudreau gold mine, in the Algoma district, Ont., and presented a favorable report.

H. C. Boydell, of the department of geology of the Massachusetts Institute of Technology, who has been in northern Ontario for some months, has returned to Boston.

G. F. Kinney has been appointed business manager of the Pittsburgh Vetagrande Mining Co. S. A., operating the Vetagrande and El Bote mines, at Zacatecas, Mexico.

A. M. Chisholm, president of the Midwest Mining Co., is inspecting his Butte property. He announces that the 800 level of the Prospector shaft will be reached by the middle of December.

Alvin Schwennesen has been transferred from Denver, Colo., to Houston, Tex., where he will have charge of all the geologic work in the Gulf Coastal region for the Roxana Petroleum Co.

George B. Bennett, formerly with the Phelps Dodge Corporation, the Jackling interests, and the U. S. Smelting company, has accepted a position with the Carson Hill Gold Mines Co., at Melones, Calif.

L. H. Timmins has been elected vice-president and **J. B. Holden** treasurer of the Hollinger Consolidated Gold Mines of Porcupine, Ont., these offices having been left vacant by the death of David A. Dunlap.

C. Maitland, an English mining engineer, is making an examination of the Rochester property of the Canadian gold mines adjacent to the Hollinger Consolidated, in conjunction with **Frank A. Loring,** consulting engineer.

Dr. W. E. Cockfield, of the Canadian Geological Survey, has returned to Ottawa after making an examination of the new Beaver Hill silver-lead field, about 60 miles north of the operating mines at Keno Hill, Yukon.

W. F. Allen, Jr., superintendent of mills of the Smuggler-Union Mining Co., of Telluride, Colo., and also the inventor of the "Allen flotation cell," will resign his position with the Smuggler-Union on Jan. 1, 1925.

Frank Krey and **Arlington Waggoner** have joined the geological staff of the Rycade Oil Co. at Houston, Tex. Mr. Krey was formerly associated with the geological surveys of Illinois and Minnesota, and Mr. Waggoner with oil-field work in Oklahoma.

A. A. Beville, of Hibbing, Minn., mining engineer, with the Cleveland-Cliffs Iron Co., has resigned from that company to accept a position as superintendent of construction and operations of the Roanoke Vitrolite & Marble Works, at Roanoke, Va.

Edmund Jussen

Edmund Jussen, mining engineer, returned recently to San Francisco from Denver, Colo., where he examined a mine near Virginia City.

S. Keough, president; **H. B. Simcox,** general manager of production; **W. L. Christana,** manager of land department; and **H. J. Packard,** chief geologist of the Mutual Oil Co. of Texas, made a tour of inspection recently of the company's Texas properties.

Fletcher Wood, who has been engaged in mining in Arizona and Mexico for several years, has been made manager of the properties of the Florence Goldfield Mining Co., at Goldfield, Nev., to succeed **Frank Oliver,** who will continue as manager of the Nevada Florence Exploration Co.

B. Dunstan, chief government geologist of Queensland, Australia, returned to Brisbane in the middle of October from the Cloncurry district of that state, after successfully conducting an aërial topographical survey of the Mount Isa silver-lead region—the first survey of the kind made in Queensland, if not in Australia.

Dr. G. B. Pritchard, chairman of directors of the Torquay Oil Wells, No Liability, Victoria, Australia, has lately been visiting the United States to obtain information regarding the oil industry here. After a trip over the southern Californian fields, he wrote home that to him had been extended the greatest courtesy by the leaders of the U. S. Geological Survey. Before returning to Australia Dr. Pritchard studied the Texas and Oklahoma fields. He has stated that offers of capital had been made to him in America to carry out oil investigations in Australia, but that he had not accepted them.

H. P. Greenwall, mining engineer with the U. S. Bureau of Mines, has returned from England, where he has been working at the Eskmeals experiment station. In a letter to the director of the Bureau of Mines the director of the station compliments highly the research work done by Mr. Greenwall in association with the British technical workers. Mr. Greenwall was sent to England as the first of an interchange of research workers. The plan is to be continued indefinitely and under its provisions British technical men will be assigned to research work here and various members of the Bureau of Mines staff will alternate in periods of work in Great Britain.

Obituary

Frank W. Hills, who had been comptroller of the American Smelting & Refining Co. since 1901, died suddenly in New York on Dec. 1. Mr. Hills was sixty-four years old. He had extensive interests in mining and smelting companies and in railroads.

David A. Welsh, whose parents were pioneers in the West, and who was well-known both in this country and abroad in copper-mining districts, died in New York suddenly on Nov. 27. Mr. Welsh was identified with the Inspiration and Anaconda companies as purchasing agent. He was forty-five years old.

Paul Neer, a mining man of Douglas, Ariz., was shot and killed by bandits at Guanacevi, Durango, Mexico, on Nov. 16. Neer was supervising construction at a mining property in a remote section of the country. His wife, who was with him, was the only American woman in camp. Neer was buried at Guanacevi.

George R. Becker, of Denver, formerly prominently identified with mining operations in New Mexico, died on Nov. 13 near Antonito, Colo., as the result of hunger and exposure suffered in an attempt to cross a snow-capped mountain range in a blizzard. He was found by a rescue party, but the extreme cold made resuscitation impossible.

Gorge W. McCaskell, a Salt Lake City mining engineer, died in Seattle, Wash., on Nov. 21. Mr. McCaskell was born in Salt Lake City, Feb. 22, 1878, and had been for five years superintendent of the Deer Trail mine, at Marysvale, Utah, which position he gave up before his death. He was a member of the Utah State Legislature, and at its last session held the position of chairman of the committee on mines and mining. Mr. McCaskell received his education in the east, and had his technical training at the Columbia School of Mines. He practised his profession throughout the West, and also visited Central America on mining business. He was for a time superintendent and general manager of the King Edward, Colonial, and Queen Alexandra mines at Cobalt, Canada. Before this time, he held positions at the Homestake mine, at Lead, S. D., and the Daly West mine at Park City, Utah.

Recent Technical Publications

Reviews, Abstracts, and References

A German Work on Nitroglycerin

Nitroglycerin und Nitroglycerinsprengstoffe (Dynamite) mit besonderer Berücksichtigung der dem Nitroglycerin verwandten und homologen Salpetersäureester. By Phokion Naoúm, Ph.D. Julius Springer, Berlin. Price $4.30.

This book, written by the chief of the research laboratories of the Alfred Nobel & Co., Dynamit-Aktiengesellschaft at Hamburg, is most attractive in being clearly impressed with sharp type on glazed paper, which presents the illustrations with great distinctness. The microphotographs of nitroglycerin crystals in the stable and labile forms, and of the flames from a variety of explosives, are markedly vivid.

Like Escales' "Nitroglycerin und Dynamit," published in Leipzig in 1908, this work deals only with nitroglycerin, its homologous esters, or substitutes, and the mixtures of them with various absorbents, or dopes, and oxidizing agents, to produce dynamites, or dynamite-like compositions of matter. For, while originally nitroglycerin was used as an explosive *per se*, just as it is still used to an extent in this country in torpedoing oil wells, Nobel found that for its successful and relatively safe use in blasting, the liquid phase must be overcome, and this he achieved by absorbing the liquid in powdered, or granular solids, like gunpowder, or infusorial silica. Thus he produced the earlier forms of dynamite. Later he found that by dissolving certain cellulose nitrates in nitroglycerin, the mass colloidized and set to a jelly. This product was styled explosive, or blasting gelatine, and by incorporating with this an explosive dope, such as a mixture of wood pulp and sodium nitrate, a gelatine dynamite was formed. Of course, with the large number of combustible substances, oxidizing and stabilizing agents, at command, a large number of mixtures have been made. Significant among them are the ammonia dynamites and ammonia gelatines, in which ammonium nitrate is made use of as the oxidizing agent.

Except for the introduction of cellulose nitrates to form blasting gelatine, in which the cellulose nitrates also replaced part of the nitroglycerin, the changes noted above were made in the dope, but changes have also been taking place in the character of the significant explosive component and for two reasons:

1. To lower the freezing point of nitroglycerin and the dynamite; and,

2. To meet the constantly increasing demand for dynamites with a constantly increasing shortage of glycerin.

Normal nitroglycerin (the glyceryl trinitrate) solidifies at about 56 deg. F., whether by itself or admixed with dopes, and it thus becomes quite insensitive to detonation, but it reacquires this sensitiveness when thawed out. This, however, is a dangerous operation, and, during the latter half of the last century and the first decade of the present, a large part of the accidents reported occurred in the thawing of frozen dynamite. Naoúm reviews the various developments in the endeavor to secure a low-freezing, or non-freezing dynamite, beginning with use of nitrobenzene, the nitrotoluenes and various other nitrosubstitution compounds; and then other nitric esters such as the nitrochlorydrins, marked success being finally reached in the use of nitrated polymerized glycerins, dating from Wohl's observations in 1890. It appears that under certain conditions the residues of two molecules of glycerin may be caused to coalesce and that from this new molecule there may be produced the tetranitrodiglycerin. With 15 per cent of this present in dynamite, the latter does not freeze. Other nitric esters exhibit similar properties.

The shortage of glycerin has been met in a measure by dissolving other alcohols, such as cane sugar and glucose, in the glycerin, and nitrating the mixture to produce "Nitrozuckeröl" or glycerin-sugar-nitrate. During the war when the shortage was very acute "synthetic glycerin" styled Fermentol or Protolglycerin was obtained by the fermentation of molasses residues and this may later be developed to commercial possibilities.

This publication deals with the manufacture, tests, uses, and characteristics of nitroglycerin, its homologues and their products. It is supplied with a detailed table of contents, an author's index, a subject index, and full bibliographic references. Since the book starts with a historical review covering 22 pages, there is some duplication, but on the whole this proves advantageous. There are relatively few Americans cited. Quite properly, Mowbray is the most conspicuously mentioned, being given credit for the introduction of compressed air into the nitration process, but R. S. Penniman, to whom we owe the successful introduction of ammonium nitrate into dynamite, is not spoken of, nor in reviewing the explosives esters do we find any reference to the splendid research of Clark Hare and Martin Boyé, which led to the discovery of ethyl perchlorate, some years before Sobrero discovered nitroglycerin, Schönbein discovered guncotton, or with their confrères, the nitro sugars, nitro starches, and other esters. But the book is, in spite of these omissions, an excellent one and will be accepted as authority and a safe guide.

CHARLES E. MUNROE.

Mineral Statistics—The Imperial Mineral Resources Bureau has recently issued the following booklets containing statistics for 1920 to 1922 inclusive: "Coal, Coke, and Byproducts," pp. 195, price 7s. 8½d.; "Iron and Steel," pp. 49, 2s. 1d.; "Zinc," pp. 66, 3s. 1d.; "Aluminium," pp. 25, price 1s. 3½d.; and "Lead," pp. 67, 2s. 7d. The data include production, consumption, and import and export statistics for the various countries of the world. Obtainable from H. M. Stationery Office, 28 Abingdon St., London, S.W. 1., England.

Patents

Electric Furnace—No. 1,512,462. Oct. 21, 1924. T. R. Haglund, Stockholm, Sweden. Ores of aluminum, silicon, or calcium are reduced in an electric furnace by solid reducing agents, at the same time forming over the reduced metal a protective covering of low specific gravity slag containing a high percentage of low specific gravity sulphides.

No. 1,514,918. Nov. 11, 1924. Charles Miller, Bridgeport, Conn., assignor to Manning, Maxwell & Moore, Inc., New York. Design for an electric arc furnace having a graphite crucible.

No. 1,515,967. Nov. 18, 1924. H. C. Reagan, Boulder, Colo. Design for an electric furnace, having two connecting and conductive hearths.

No. 1,516,651. Nov. 25, 1924. Filip Tharaldsen, Christiania, Norway. A process for producing zinc in electric furnaces. The heating element or arc is at the center of the furnace chamber, from which the ore charge slopes upward to the outer corners of the smelting chamber. The fresh charge, as added, smelts as it falls down the incline toward the source of heat.

Drill Steel Heater—No. 1,515,593. Nov. 18, 1924. William Elsdon-Dew, Leslie Pryce, and L. B. Woodworth, Johannesburg, Transvaal. An electric induction furnace for heating drill bits.

Drill Bit—No. 1,516,601. Nov. 25, 1924. A. L. Hawkesworth, Butte, Mont., assignor to Hawkesworth Drill Co., Butte. Method of securing a drill bit in the shank.

Jig—No. 1,516,338. Nov. 18, 1924. A. C. Daman, Denver, Colo. A hydraulic jig arranged to pulsate by means of a magnetic core reciprocating within a solenoid.

Petroleum—No. 1,516,340. Nov. 18, 1924. H. H. Holdaway and R. H. Challacombe, Los Angeles, assignors to Petroleum Engineering Corporation. Design for a rotary drilling bit using disk cutters.

No. 1,516,534. Nov. 25, 1924. R. A. Hughes, Cygnet, Ohio. Design for a working valve for an oil well.

No. 1,516,791. Nov. 25, 1924. Luther Robinson, Eldorado, Kansas. An oil-well swab.

Ball Mill—No. 1,516,467. Nov. 18, 1924. John Herman, Los Angeles. A screening lining for a ball mill, consisting of sections of railroad rails bolted to a peripheral screen.

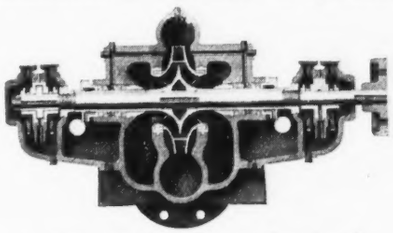
Nitrate Recovery — No. 1,516,550. Nov. 25, 1924. E. A. Cappelen Smith, New York City, assignor to Guggenheim Bros., New York. A cyclic method for extracting nitrate from caliche by leaching the caliche at temperatures below 60 deg. C., and precipitating the sodium nitrate by refrigeration carried out in successive stages. The cold mother liquor is used for further leaching.

No. 1,517,046. Nov. 25, 1924. C. L. Burdick, New York City, assignor to Guggenheim Bros., New York. Leaching of the caliche is carried out at temperatures under 58 deg. C. in the presence of certain agents having the property of rendering stable certain protective sulphate compounds in the presence of free nitrate.

New Machinery and Inventions

Improved Low-Head Centrifugal Pump Introduced

A new low-head centrifugal pump is being brought out by the Allis-Chalmers Manufacturing Co. as an addition to its Type "S" line. This pump will be built in the smaller sizes and will be similar to the Type "S," except that it will have incorporated a number of mechanical improvements. It will also be higher in efficiency, because of the elimination of a number of hydraulic



Cross-section of new low-head centrifugal pump

losses. That these improvements may be visualized a cross-section of the new pump is given in the accompanying cut. A few of the more important features are as follows:

1. Bronze companion wearing rings. Wearing rings are L shaped to reduce disturbance in suction passages and increase efficiency.

2. Split bronze inclosed glands with drain to prevent water being thrown off or entering bearings.

3. Stuffing box throat provided with bronze bushings.

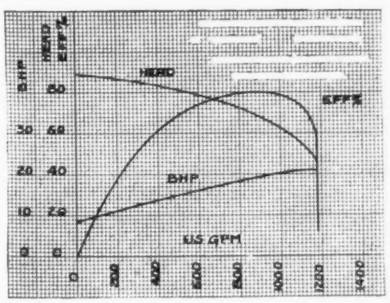
4. Annealed steel shaft with removable cast bronze sleeves extending from runner hub to the inside or bearing housing.

5. Double-acting center-collar thrust bearing on outboard end, firmly fixed and locked in place; it does not become loose, it is claimed.

6. Split-bearing shells with two oil rings. Oil is led to the center of the bearing, being thus kept away from the ends and, in addition, affording a circulation.

7. Self-closing oil hole covers, with dust covers at ends and Gits oil level indicating cups on side of bearings.

8. Water-seal passages integral in the upper half casing; can be arranged for outside seal when necessary.



Characteristic curves for 5-in. type S centrifugal pump at 1,750 r.p.m.

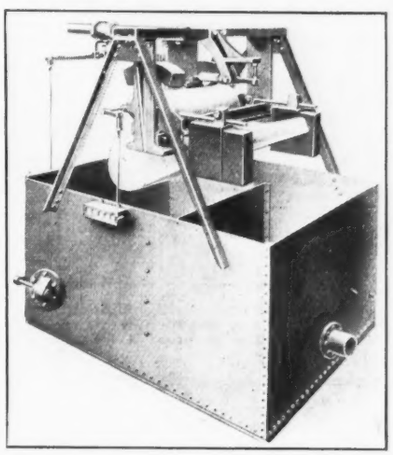
9. Shaft nuts are designed to act as oil throwers to keep oil in bearings. Shaft sleeves are designed to prevent any water which might creep along the shaft from entering the bearings.

Better to illustrate the performance of this pump characteristic curves of the new 5-in. pump are herewith shown. It will be noted that for 900 gal. against 68 ft. head an efficiency of 80 per cent was obtained. The efficiency was over 70 per cent from 520 g.p.m. to 1,120 g.p.m.

A Meter for Weighing Liquids

A weighing meter that actually weighs the liquid by balancing a bucket against a balance weight on a scale beam is being made by the H. S. B. W. Cochrane Corporation, Philadelphia, Pa. The beam is supported on knife-edge bearings and the bucket rests upon the beam by means of frictionless trunnions.

When a certain weight of water has accumulated in the bucket, the latter sinks until it escapes a latch, and turns over quickly to discharge its contents. During the time the bucket is rotating the inflowing water is received in a detaining chamber. As soon as the bucket has discharged it swings back so that the liquid in the detaining chamber flows into the main bucket and it revolves slowly to its original position. Doing this, it travels a short distance past the latch and, as more water flows in it, comes back slowly against the latch and engages and locks with it as the balance weight has already returned the bucket to its original elevation.



This meter is used for weighing liquids
The bucket is balanced against a weight on a scale beam. When the liquid flowing into the bucket reaches a certain point, the bucket sinks, escapes a latch, and discharges

Each dumping is registered by a counting train and the accuracy is within 1 per cent, plus or minus, at all rates of flow up to the maximum. The meter is calibrated by weighing a single discharge, and it can be adjusted by moving one or, if desired, both of the counterweights.

Indicating Caliper Useful for Shop Work

A caliper which gives a visual and instant reading to show the amount of stock still to be removed or how much the work is undersize is a handy instrument in any shop. In use this instrument is set to any desired sample with the hand on the "0" of the dial and the back stop is arranged so that

This caliper instantly shows amount of stock still to be removed

the work is centrally located on the contact points. By trying the work from time to time in the caliper which has been set to a sample in this fashion, the dial indicates the amount of material necessary to remove. Where the hand goes below "0" too much metal has been removed. This caliper is made by the F. W. Horstmann Co., 196 Coit St., Irvington, N. J.

Nordberg Will Make Shuveloder

The Nordberg Manufacturing Co., of Milwaukee, Wis., has announced that it has taken over the license to build and sell the Armstrong Model 12 Shuveloder, which will be made complete in the Nordberg plant. This machine has been on the market for some time, and a large number are in service. This, however, will be the first time that the machine will be sold under the name of the Nordberg company.

Trade Catalogs

Clamshell Buckets — Booklet 8-24, issued by the Brown Hoisting Machinery Co., Cleveland, Ohio, describes Brownhoist clamshell buckets. It contains eight pages and is well illustrated.

Rust Prevention—"Rust and Rust Prevention" is the title of a small 16-page pamphlet describing a compound known as "Vatu" manufactured by the American Rust Proof Co., 8 West 40th St., New York. This compound is a liquid that may be applied with a rag or brush or used as a spray or a dip.

The Market Report

Daily Prices of Metals

Nov. Dec.	Copper, N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
27	.....	.....	.....	....	.....	.....
28	13.75	54.25	54.75	8.65	8.40@8.75	7.00@7.05
29	13.85	54.50	55.00	8.65	8.40@8.75	7.05
1	13.85	54.75	55.25	8.65	8.40@8.75	7.05@7.075
2	13.875@14.00	54.625	55.125	8 70	8.40@8.75	7.05@7.075
3	14.00	54.50	55.00	8.65	8.40@8.75	7.05
Av.	13.878	54.525	55.025	8.66	8.575	7.05

*These prices correspond to the following quotations for copper delivered: Nov. 28th, 14c.; 29th and Dec. 1st, 14.10c.; 2d, 14.125@14.25c.; 3d, 14.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. **For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes.** Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of ***Engineering and Mining Journal-Press*** and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Nov. Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
27	63 3/4	64 7/8	68 1/4	258 3/8	261	40 5/8	37 3/4	35 9/16	35 1/4
28	63 7/8	65	68 1/2	258 3/4	261 1/4	40 3/4	37 13/16	35 3/4	35 1/2
1	64 1/4	65 3/8	69	261	263 1/2	39 7/8	37 5/16	35 15/16	35 3/4
2	64 1/4	65 3/8	69	260 1/2	263 1/4	40	37 3/4	35 15/16	35 11/16
3	64 1/4	65 1/4	69	259 1/4	262	39 5/8	37 1/4	35 9/16	35 1/2

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
27	.....	....	33 5/16	89s 10d	1	4.63 1/2	69 1/4	33 3/8	89s 11d
28	4.63 1/2	69 1/4	33 9/16	89s 11d	2	4.64 3/8	69 1/4	33 3/8	89s 8d
29	4 62 1/8	69	33 7/16	... ...	3	4.65 3/8	69	33 3/16	89s 6d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for November

Copper:	
New York Electrolytic.....	13.635
London Standard	63.731
London Electrolytic	68.063
Lead:	
New York	8.689
St. Louis	8.590
London	39.425
Silver:	
New York	69.299
London	33.775
Sterling Exchange	460.543
Zinc:	
St. Louis	6.796
London	35.022
Tin:	
99 per cent	53.848
Straits	54.348
London	257.738
Quicksilver	68.708
Antimony	14.385
Platinum:	
Refined	117.792
Crude	111.333

Huge Copper Sales Made as Prices Rise

New York, Dec. 3, 1924—Buying of a record tonnage of copper in the domestic market was easily the feature of the week, prices exhibiting another gradual advance to 14¼c. delivered, today, the highest price since Aug. 9, 1923. Moderate tonnages of zinc were sold, the price going above 7c. for the first time since April 19, 1923. The demand for lead and tin has been somewhat less, though prices are holding firm.

Copper Passes 14c., Delivered

Not for a long time has such heavy buying featured the copper market. Six sellers report a total of 52,000,000 lb. sold to domestic consumers in four days. Producers are much encouraged that large and careful buyers have seen fit to enter the market at the current levels.

On Monday, most of the copper was sold at 14⅛c. delivered in the East, though at least one lot was bought up for as low as 14c. Yesterday morning 14⅛c. was the general level, but in the afternoon numerous sales were made at 14¼c., a price which also holds today, though one seller was said to be offering at 14.20c.

Lead Somewhat Quieter

The official contract price of the American Smelting & Refining Co. for lead continues at 8.65c., New York. Outside interests continue to quote 9c. but the business done at the higher level has been insignificant compared with last week, and has been almost entirely confined to an occasional carload of special brands. December lead is admittedly scarce, but consumers seem well provided for until January. Conditions remain unchanged in the Middle West, with one producer allotting limited tonnages at 8.40c., St. Louis, while others are getting from 8.70 to 8.80c.

Zinc Continues Advance

Good domestic and export buying of zinc continued during the week, the 7c. level being reached and passed. The upward movement depends on a continuance of foreign buying, but there seems no reason why this should not continue. New York prices are as formerly, 35c. per 100 lb. above St. Louis, and high-grade zinc is unchanged at 8@8¼c. delivered.

Tin Market Quiet

Tin buying was confined to small tonnages in general and the price showed little variation from the 55c. level, either for spot or forward. Apparently there is no indication of an early advance in London.

Silver Steady and Quiet

New York silver prices have held steady in a quiet market. Sterling exchange has advanced slightly, but the London market has correspondingly declined.

Mexican Dollars—Nov. 27, holiday; 28th, 53⅜c.; 29th, 53¼c.; Dec. 1, 53⅜c.; 2d, 53⅜; 3d, 53¼c.

Sterling at New High

During the week, sterling exchange has registered a new high for two years, and other European exchanges have been stronger also. On Tuesday, Dec. 2, closing cable quotations on francs were 5.4825c.; lire, 4.355c.; and marks, 23.82c. Canadian dollars, $\frac{3}{32}$ per cent discount.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £125 long ton.

Antimony—Per lb.:
Chinese brands, 14¼c.
Cookson's "C" grade, 17¾c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½c.
White oxide, Chinese, 99 per cent Sb_2O_3, 13@14c.

Bismuth—$1.50@$1.55 per lb. London, 6s.

Cadmium — 60c. per lb. London, 2s. 2d.@2s. 6d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 9s. for black oxide.

Germanium Oxide—25 to 50 gm. lots, $10 per gm.

Iridium—$325 per oz. Nominal.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, 90c.@$1 per lb. London quotes 4s. for 99 per cent.

[1]**Molybdenum—99 per cent, $12 per lb.**

Monel Metal—32c. per lb.

Nickel—Ingot, 29c.; shot, 30c.; electrolytic, 33c. (99.75 per cent grade).

Osmiridium—Crude, $58.50 per oz.

Osmium—$100@$104 per troy oz.

Palladium—$79@$83 per oz. Crude, $60 per oz. London, £19.

Platinum—Refined, $117 per oz. Crude $111.

Quicksilver—$68@$70 per 75-lb. flask. Importers generally asking $70 now owing to increased strength of European market. London up to £10¾. San Francisco wires $70.

Radium—$70 per mg. radium content.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tantalum—Metal, $350 per kg.

Tellurium—$2 per lb.

[1]**Thallium Metal—Ingot, 99 per cent** pure, $5 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

[1]**Zirconium Metal—98 per cent grade, per lb., $30.**

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:
Indian, $18.50@$19.50.
Rhodesian, $21.50.
New Caledonian, $24.
Market nominal.

[1]**Galena Radio Crystals**—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500-lb. lots, f.o.b. Philadelphia.

Iron Ore—Prices for iron ore and magnetite for 1924 season were published Aug. 9.

Manganese Ore—39@41c. per long ton unit, seaport, plus duty. Nominal. Chemical grades[1], powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, Caucasian, and Javanese, $75@$80 per ton in carloads.

Molybdenum Ore—65@75c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Pyrite Radio Crystals—(Best quality) $1.50 per lb. in 500-lb. lots.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $8.75@$9.
High-grade scheelite, $9@$9.25.
Ordinary grades, $8.75.
Market nominal.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Zinc Ore Higher—Lead Firm

Joplin, Mo., Nov. 29, 1924

Zinc Blende	Per Ton
High	$48.70
Premium, basis 60 per cent zinc	$48.00@$49.00
Prime Western, 60 per cent zinc	$47.00@$48.00
Fines and slimes	$46.00@$42.00
Average settling price, all	$46.03

Lead Ore	
High	$122.65
Basis 80 per cent lead	$120.00
Average settling price, all	$121.11

Shipment for the week: Blende, 16,538; lead, 2,009 tons. Value, all ores the week, $1,065,010.

Shipment for eleven months: Blende, 673,069; calamine, 372; lead, 88,499 tons. Value, all ores eleven months, $37,307,570.

Buyers concede $48 and $49 basis is being paid for premium, the latter for lead-free ore, but admit only $47 basis Prime Western, though sellers claim to have sold on $48 basis. Buying continued to 5:45 p.m. and totaled 20,750 tons.

Buyers are checking up on ore sold ahead of production, several of them being unable to get the ore purchased a week or two weeks ago.

Platteville, Wis., Nov. 29, 1924

Zinc	Per Ton
Blende, basis 60 per cent zinc	$48.00

Lead	
Lead, basis 80 per cent lead	$122.50

Shipments for the week: Blende, 795 tons; lead, 80 tons. Shipments for the year: Blende, 29,046; lead, 1,426 tons. Shipments for the week to separating plants, 1,464 tons blende.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Asbestos:
Crude No. 1—$300@$325.
Crude No. 2—$175@$215.
Spinning fibers—$90@$125.
Magnesia and compressed sheet fibers—$50@$80.
Shingle stock—$45@$50.
Paper stock—$30@$35.
Cement stock—$15@$25.
Floats—$9@$12.
Sand—$6@$8.
All per short ton, f.o.b. mines, Quebec, tax and bags included.
No. 1 Rhodesian crude, $280; No. 2, $175 per short ton, c.i.f. New York.
Good demand for short fibers, but only moderate demand for longer grades.

Barytes—Crude—$8.50 per ton, Missouri mines, 90@98 per cent $BaSO_4$; $8.50 per ton, f.o.b. Georgia mines; $6@$8, at Baltimore.
Ground—Off color, $13 per ton, Baltimore; white, $17, Baltimore.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.
Noticeably steady demand.

Bauxite—American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.75.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign, per metric ton, c.i.f.:
French, 5 per cent SiO_2, $5@$7.
Dalmatian, low SiO_2, $5@$7.50.

Beryl—$75@$85 per ton, hand-sorted crystals, f.o.b. New York. Nominal.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 4¾c. per lb.; in bbls., 5c. Boric acid, 10½c.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $40 per ton in carload lots.

Chalk—F.o.b. New York, per lb.:
English, extra light, 5c.
Domestic, light, 4¼@4½c.
Domestic, heavy, 3½@3¾c.
In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:
Crude No. 1, $7.
Crude No. 2, $5.50.
Washed, $8.
Powdered, $10@$20.
Powdered (Blue Ridge), $12@$15.
Imported English, f.o.b. American ports:
Lump, $11@$18.
Powdered, $45@$50.
1A grades, domestic, $16@$17, f.o.b. mines.

Corundum — South African, $65 per ton, New York.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, ¼ in., $45.
Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.
Business reported satisfactory.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 6½c.
American, 4@6½c.
Market fair.

Feldspar—Per long ton, f.o.b. cars,
North Carolina:
No. 1 pottery grade, $6.50@$7.50, depending upon quality.

No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.
Good market for best grade.

In *Connecticut*, per net ton, f.o.b. mines:
40 to 200 mesh, $17@$30.
Some producers predict shortage this winter.

In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not exceeding 10 per cent SiO_2, $7.70.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market fair. Inquiries increasing.

In *New York*, per ton, f.o.b. cars:
No. 1, $8. Market still dull.

In *Maine:*
No. 1 ground, $19. Business good and ahead of last year.

In *Tennessee:*
Pottery grades, $15.30@$18.
Tile grades, $14@$16.
Enameling grades, $11@$16.
Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.
Market fair.

In *Canada:*
No. 1 crude, $7 per short ton.
No. 1 ground, 120 mesh, $25.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Gravel, not less than 80 per cent CaF_2, and not over 5 per cent SiO_2, $17.50.
Gravel, not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $18.50.
Lump, not less than 85 per cent CaF_2, not over 5 per cent SiO_2, $18.50.
Ground, 93 to 98.5 per cent CaF_2 and not over 3 per cent SiO_2, $30@$35 in bulk, $39 in bags or barrels.
Acid, ground, not less than 98½ per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $49 in packages.
Business of fair volume but highly competitive in the Middle West. Liquidation of surplus stocks not so pressing. Market growing stronger.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colorado:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 5½@6c.
Ceylon chip, 4½@5c.
Ceylon dust, 2½@3½c.
Crude amorphous, $15@$35 per ton.
Flake, No. 1 and No. 2 from New York, 25@30c.

Manufactured grades:
No. 1 Flake, lubricating, 15@30c.
No. 2 Flake, lubricating, 8@12c.
Powdered, best grade, 15@60c.
Powdered, seconds, 5@12c.
Facings, 4@8c.
Market unsettled, prices of foreign graphite somewhat higher. Better business and prices looked for. Graphite business has been a losing one for the miners.

Gypsum—Per ton, depending upon source:
Crushed rock, $2.75@$3.
Ground, $4@$6.
Agricultural, $6@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $60 per short ton, Florida mines.

Iron Oxide (See Ocher) — Ground, 95 per cent through 200 mesh, Standard Spanish red, $45 per ton.

Kaolin—See China Clay.

Lepidolite—$20@$30 per ton for ordinary grades. Nominal.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $42.50.
Dead burned, $29@$31, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.
Demand keeping up.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 6c. per lb.
Grade "AC," 7c. per lb.
Grade "AA," fine, 8c. per lb.
Grade "C," fine and lump, 9c.
Grade "C," lump, 12c.

Mica—
North Carolina prices:
Scrap, $17@$20 per ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1¼ in., 7c.
1½ x 2 in., 16c. 3 x 4 in., $1.75.
2 x 2 in., 30c. 3 x 5 in., $2.35.
2 x 3 in., 75c. 4 x 6 in., $3.
3 x 3 in., $1.25. 6 x 8 in., $4.50.
Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
Dry ground, roofing, $30.
Dry ground, 80 mesh, $35.
Dry ground, 100 mesh, $67.50.
Dry ground, 160 mesh, $70.00.
In *New Hampshire:*
Washer and disk, $320 per ton.
Scrap, $24 per ton.

[1]**Monazite**—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines.

Ozocerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 24@25c.
Green, 170 deg. melting point, 26@30c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $5.75.
75 per cent, $5.50.
74@75 per cent, $5.25.
70 per cent, $3.35.
68 per cent, $3.

In *Tennessee*, per long ton:
78 per cent lump, $8.
75 per cent hand-mined lump, $6.75.
75 per cent washed lump, $7.
72 per cent washed run of mine, $5.50.
65 per cent ground 95 per cent through 100 mesh, $7 per short ton.
Market fair.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent	$34.55	$33.30
Sulphate of potash 90@95 per cent, basis 90 per cent	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent	19.03	17.33
Manure salt 20 per cent	12.55	10.55
Kainit 14 per cent	10.25	8.25
Kainit 12.4 per cent	9.75	7.75

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

For prompt shipment:
5 per cent on minimum quantity of 50 short tons K_2O
6 per cent on minimum quantity of 100 short tons K_2O
7 per cent on minimum quantity of 300 short tons K_2O
10 per cent on minimum quantity of 500 short tons K_2O

The calculations are on total quantity of foreign potash salts imported during the present fertilizer year ending on April 30, 1925.

On all orders received prior to Oct. 1, 1924, for prompt shipment, a summer rebate of 5 per cent on net prices was allowed.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 11c.
Fines, through ½ in., 11½c.
Cinder from ore to remain property of buyers.

Quartz Rock Crystals — Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 40c. per lb. in ton lots.
For optical purposes, double above prices.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, $200 per ton, Florida, delivered.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
450 mesh, $31@$34.
350 mesh, $25@$28.
250 mesh, $23.
200 mesh, $20.
100 mesh, $8.
Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25.

Spodumene — $20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s New York.

Talc—Per ton, in 50-lb. paper bags, *Vermont* mills, carloads:
Ground, 200 mesh, extra white, $10.50.
Ground, 180 mesh, medium white, $10.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Ground, 160 mesh, medium white, $9.50.

In *New York*, double air-floated, including containers:
200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand fair.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:
Gray or yellow, $7.50@$10.
Red or white, $10@$14.
Market good for powders.
White, $12@$15.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.
Improved market.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:
Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.
Double ground:
Rose and cream, $17@$25.
White, $19@$30.
Air-float:
Rose and cream, $25@$30.
White, $35.
Market steady.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—6½@6¾c. per lb. delivered.

Copper Sulphate—4.65c. per lb.

Sodium Nitrate—$2.40 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$16@$17 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7⅝c.
5 per cent lead sulphate, 6⅞c.
10 to 35 per cent lead sulphate, 6⅝c.
French, red seal, 9⅝c.
French, green seal, 10⅝c.
French, white seal, 11⅝c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 10¾c. per lb.

Ferromanganese—Domestic and foreign, 78@82 per cent, $105 per gross ton. Spiegeleisen, 19@21 per cent, $32, f.o.b. furnace; 16@19 per cent, $31.

Ferromolybdenum—$1.80@$2 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $39.50 @$43.50 per gross ton, f.o.b. works; 50 per cent, $72@$75 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 85@90c. per lb. of contained W, f.o.b. works. Quiet.

[1]**Ferro-uranium**—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.25@$4 per lb. of V contained, f.o.b. works.

Metal Products

Rolled Copper—Sheets, 21⅝c.; wire, 16⅜c.

Lead Sheets—Full lead sheets, 12c. per lb.; cut lead sheets, 12¼c. in quantity, mill lots.

Nickel Silver—27⅜c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 18⅝c. per lb.; rods, 16⅝c. per lb.

Zinc Sheets — 10.75c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$45@$47 per net ton, f.o.b. shipping point.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Firebrick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $33@$37.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$33@$35 per M. Pennsylvania; $48@$50 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

Iron Trade Hopeful

Pittsburgh, Dec. 2, 1924

The course of the steel market in the four weeks since the election represents a change in sentiment and policy of buyers and sellers rather than a change in underlying conditions. Better business is expected for 1925 than there has been this year, although business has not been bad. Buyers have been more ready to buy, which stiffens the position of mills, and this mill attitude has in turn encouraged buying.

The sheet advance, for first quarter, announced by the Steel Corporation, has brought in a large tonnage of business, and a little business, over first quarter, is now coming in at the new prices. The majority of independents have not yet advanced. In bars, shapes, and plates business is now being secured at the recent advance. Mill operations are fully 70 per cent, against 66 per cent in October.

Pig Iron — The minimum of the market is up 50c. all around, and there are sales of foundry iron for extended delivery at well above the minimum. Bessemer, $21; basic, $19.50@$20; foundry, $20.50@$21.50, f.o.b. Valley furnaces.

Connellsville Coke—Most of the contracting for first-quarter furnace coke was done at $3.25, recent contracts having been at $3.50, with one at $3.75. Spot furnace is stronger, at $3.25, also smelter coke at $2.90@$3.15, foundry remaining quiet at $4@$4.50.

Imports and Exports of Ores and Metals in October, 1923 and 1924

Imports and exports of certain metals and ores during October, 1924, with revised comparative figures for October, 1923, as compiled by the Department of Commerce, are as follows:

Imports

In Pounds, Unless Otherwise Stated

	October, 1923	October, 1924
Antimony		
Ore	253,046	61,689
Liquated, regulus or metal	1,478,848	744,755
Copper		
Ore	12,557,837	1,798,794
Concentrates	2,146,926	2,288,220
Regulus, coarse metal, and cement copper	32,648	40,972
Total	14,737,411	4,127,986
Unrefined, black, blister and converter copper in pigs, bars, and other forms	36,810,274	33,852,068
Refined copper	10,208,701	6,807,557
Old and clippings for remanufacture	277,849	234,693
Composition metal, copper chief value	4,061	
Copper manufactures	2,603	13,556
Brass		
Old and clippings for remanufacture	958,329	401,184
Manufactures of brass	73,101	113,858
Lead		
Ore and matte	11,174,809	7,569,841
Bullion or base bullion	16,833,302	11,921,933
Pigs, bars, other forms and old	1,438	135,561
Manufactures of, except type metal	27,772	198,230
Manganese ore, long tons	16,842	12,088
Pyrites, long tons		12,857
Tin		
Tin ore, tons	585	33
In blocks, bars, and pigs	13,068,967	10,070,127
Zinc		
Ore		
Dutiable	609,621	355,606
Blocks, pigs, and other forms	1,109	10,064
Zinc dust	23,247	7,500

Exports of Copper, Lead and Zinc

In Pounds

	October, 1923	October, 1924
Copper		
Ores, concentrates, matte and regulus	111,919	500
Copper and manufactures of	76,310,563	93,523,412
Refined in ingots, bars, and other forms	68,040,377	83,509,744
Old and scrap copper	239,042	320,130
Composition metal, copper chief value	5,377	1,087
Pipes and tubes	379,531	270,425
Plates and sheets	669,068	1,004,838
Rods	4,810,972	4,837,423
Wire	1,047,848	1,112,844
Insulated copper wire and cable	951,773	1,959,594
Other manufactures of copper	166,575	507,327
Lead		
Pigs, bars and other forms	9,801,779	13,269,422
From domestic ore	85,640	1,173,484
From foreign ore	9,715,639	12,095,938
Other lead manufactures	795,887	2,349,009
Tin in bars, blocks or pigs	107,998	103,935
Tin manufactures	821,530	646,609
Zinc		
Ores, concentrates, and dross	5,816,990	2,624,204
Zinc (spelter) in slabs, blocks, or pigs	9,300,668	12,195,237
In sheets, strips, and other forms	497,720	425,815
Zinc dust	580,293	377,366
Other zinc manufactures	30,927	56,34

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1923	1924	1923	1924	1923	1924
January	65.668	63.447	31.928	33.549	465.053	425.524
February	64.313	64.359	30.875	33.565	468.631	430.457
March	67.556	63.957	32.310	33.483	469.269	428.769
April	66.855	64.139	32.346	33.065	465.220	434.788
May	67.043	65.524	32.611	33.870	462.252	435.716
June	64.861	66.690	31.611	34.758	461.132	431.675
July	63.015	67.159	30.942	34.509	458.025	436.649
August	62.793	68.519	30.952	34.213	455.714	449.510
September	64.203	69.350	31.698	34.832	453.901	445.740
October	63.649	70.827	31.718	35.387	452.024	448.274
November	63.818	69.299	32.774	33.775	437.839	460.543
December	64.705	.....	33.375	.....	435.500	.....
Year	64.873	.....	31.929	.....	457.047	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1923	1924	1923	1924	1923	1924
January	14.510	12.401	64.494	61.273	71.409	67.193
February	15.355	12.708	67.700	63.113	74.500	68.167
March	16.832	13.515	73.851	66.137	81.464	72.087
April	16.663	13.206	73.169	64.338	81.331	70.150
May	15.440	12.772	67.460	62.006	76.568	67.648
June	14.663	12.327	66.607	61.375	73.238	66.313
July	14.321	12.390	65.278	61.652	72.364	65.815
August	13.822	13.221	64.034	63.481	70.000	67.800
September	13.323	12.917	63.194	62.750	68.275	67.125
October	12.574	12.933	60.614	62.641	64.250	66.620
November	12.727	13.635	61.648	63.731	66.477	68.063
December	12.823	.....	62.035	.....	67.611	.....
Year	14.421	.....	65.840	.....	72.291	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1923	1924	1923	1924	1923	1924
January	7.633	7.972	7.571	8.002	27.119	31.528
February	8.050	8.554	8.093	8.643	28.519	34.589
March	8.252	9.013	8.254	8.891	28.815	37.161
April	8.101	8.263	7.996	7.932	26.956	32.819
May	7.306	7.269	7.085	6.973	25.614	29.426
June	7.146	7.020	6.852	6.848	25.429	32.138
July	6.237	7.117	6.126	6.886	24.188	32.916
August	6.582	7.827	6.496	7.764	24.222	32.744
September	6.856	8.00	6.700	7.876	25.688	33.023
October	6.831	8.235	6.570	8.118	27.815	35.715
November	6.846	8.689	6.582	8.590	30.352	39.425
December	7.369	.....	7.369	.....	31.042	.....
	7.267	.....	7.141	.....	27.147	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1923	1924	1923	1924	1923	1924
January	37.986	48.250	39.173	48.750	181.852	246.790
February	40.693	52.772	42.011	53.272	190.513	272.399
March	46.569	54.370	48.569	54.870	219.607	277.429
April	44.280	49.457	45.810	49.957	213.081	250.863
May	42.346	43.611	43.135	44.111	203.097	218.511
June	40.375	42.265	40.957	42.765	191.798	219.219
July	37.970	45.750	38.490	46.250	181.188	233.332
August	38.841	51.409	39.269	51.909	186.705	254.638
September	41.047	48.595	41.547	49.095	198.263	243.511
October	41.322	50.038	41.851	50.538	203.957	248.543
November	43.495	53.848	43.995	54.348	220.710	257.738
December	46.662	.....	47.160	.....	235.007	.....
Year	41.799	.....	42.664	.....	202.148	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1923	1924	1923	1924
January	6.815	6.426	35.733	34.761
February	7.152	6.756	35.613	36.518
March	7.706	6.488	36.720	35.298
April	7.197	6.121	34.275	32.588
May	6.625	5.793	31.057	30.648
June	6.031	5.792	29.548	31.788
July	6.089	5.898	29.335	32.193
August	6.325	6.175	32.386	32.544
September	6.438	6.181	33.469	32.926
October	6.293	6.324	32.995	33.514
November	6.347	6.796	32.949	35.022
December	6.260	.....	32.611	.....
Year	6.607	.....	33.058	....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1923	1924	1923	1924	1923	1924	1924
January	6.884	10.279	72.731	59.500	112.462	122.115	115.500
February	7.290	10.935	70.636	59.565	113.273	124.739	115.935
March	8.885	11.442	70.808	64.269	110.846	121.692	113.231
April	8.380	9.952	69.200	74.308	116.840	115.577	108.077
May	7.477	8.755	68.000	76.962	115.007	115.731	112.192
June	6.839	8.403	67.769	73.720	115.615	116.000	113.000
July	7.097	8.477	66.980	72.173	116.000	118.231	113.865
August	7.753	9.839	65.212	72.096	116.000	120.000	113.500
September	7.633	11.022	63.000	72.423	116.000	118.923	113.058
October	8.005	11.519	61.769	70.654	116.923	118.000	112.423
November	9.156	14.385	61.917	68.708	124.479	117.792	111.333
December	9.365	.....	60.000	.....	125.000	.....	.....
Year	7.897	.....	66.502	.....	116.537	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1923	1924	1923	1924	1923	1924
January	29.27	24.76	27.35	23.76	28.77	23.88
February	29.79	25.26	28.15	23.76	27.21	25.06
March	32.03	25.14	31.79	23.76	31.77	24.76
April	32.77	24.56	32.77	23.26	32.77	23.80
May	31.87	23.89	29.83	22.08	32.46	22.91
June	30.27	22.90	28.34	21.49	29.81	21.48
July	28.47	21.90	26.52	20.76	27.47	20.76
August	28.27	21.76	26.77	20.76	26.77	20.99
September	28.26	21.76	26.26	20.76	26.72	21.68
October	26.96	21.76	25.01	20.26	25.52	21.26
November	24.79	22.08	22.57	21.44	23.60	21.17
December	24.54	.....	22.62	.....	23.72	.....
Year	28.94	.....	27.33	.....	28.05	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1924			
	July	August	September	October
Alaska shipments	9,949,406	138,760	3,602,468	11,651,471
Calumet & Arizona	2,732,000	3,802,000	3,448,000	4,444,000
Miami	4,806,000	5,108,000	4,099,000	4,895,000
New Cornelia	4,427,373	5,627,261	5,096,158	5,069,899
Old Dominion	2,321,000	2,455,000	2,495,000	3,004,000
Phelps Dodge	12,248,000	12,341,000	11,958,000	13,156,156
United Verde Extension	3,474,178	4,011,746	5,268,896	3,539,538
A.S. & R. & Tenn. Copper	18,500,000	12,000,000	14,750,000	13,500,000
Imports: Ore and concentrates, matte	10,037,156	12,354,191	11,759,019	4,127,986
Partly from				
Chile	3,514,581	3,687,191	5,939,411	.....
Cuba	2,537,920	2,685,000	2,560,000	.....
Canada	282,689	2,073,966	319,724	.....
Mexico	2,084,239	2,128,722	1,800,113	.....
Imports of black and blister, unrefined	36,245,999	29,215,759	27,024,684	33,852,068
Partly from				
Chile	12,405,405	4,097,634	8,022,886	.....
Peru	5,427,330	6,936,387	3,824,548	.....
Africa	8,512,932	8,536,719	6,141,793	.....
Mexico	3,599,039	3,843,264	4,512,257	.....
Imports of refined and old	17,102,388	16,647,115	15,216,096	7,055,806

Foreign

Boleo, Mexico	1,314,275	1,258,030	1,433,148	1,572,165
Falcon Mines, Rhodesia	466,000	474,000	479,200	.....
Furukawa, Japan	2,601,374	2,594,205	3,936,792	.....
Cons. M & S., Canada	674,000	416,865	270,380	.....
Granby Cons., Canada	3,120,904	2,238,146	1,508,786	2,312,348
Katanga, Africa	18,861,570	20,411,685	17,293,815	16,638,930
Mount Morgan, Aust	916,000	.....	.....	.....
Mount Lyell, Aust	750,000	786,000	.....	.....
Phelps Dodge Mexican	4,002,000	3,292,000	3,792,000	3,487,000
Sumitomo, Japan	3,004,986	2,519,542	3,350,001	.....

Comparative U. S. Copper Mine Production

	1921	1922	1923	1924
January	90,596,597	32,010,292	112,267,000	133,356,000
February	86,682,941	45,957,530	102,725,000	128,260,000
March	91,046,345	55,705,760	121,562,000	129,816,000
April	46,946,523	76,601,000	118,157,000	131,928,000
May	25,310,511	88,714,000	125,438,000	130,644,000
June	24,623,693	93,740,000	125,479,000	127,506,000
July	22,033,739	91,000,000	125,249,000	129,574,000
August	23,248,398	101,188,000	131,088,000	133,512,000
September	23,855,316	96,408,000	124,523,000	126,346,000
October	23,231,572	103,273,000	132,481,000	138,862,000
November	28,341,442	102,845,000	127,963,000	.....
December	26,629,137	103,003,000	129,354,000	.....

Company Reports

Burma Corporation, Ltd.

The fourth annual report of the Burma Corporation for the year ended June 30, 1924, states that progress has been made in all departments.

Below are given the comparative figures of production of refined lead and fine silver:

	Twelve Months to Dec. 31, 1922	Twelve Months to June 30, 1924	Per Cent Increase
Refined lead (tons)	39,213	47,109	20.14
Silver (oz.)	4,191,819	5,114,721	22.02
	Six Months to June 30, 1923	Six Months to June 30, 1924	
Refined lead (tons)	21,654	24,212	11.81
Silver (oz.)	2,266,874	2,554,848	12.7

The profit-and-loss account discloses a surplus of Rs. 1,61,01,080.11.7 (£1,073,405 7s. 8d.) on the year's working, after debiting all operating expenditure. This is an increase of Rs. 60,95,842.0.5 (£406,389 9s. 4d.), compared with the twelve months to Dec. 31, 1922. Sterling figures calculated at 1s. 4d. per rupee.

After charging to appropriation account the various items enumerated therein, a net profit is shown of Rs. 86,18,671.2.1 (£574,578 1s. 6d.), which compares with Rs. 42,52,112.2.11 (£283,474 2s. 11d.) for the twelve months ended Dec. 31, 1922; an increase of no less than Rs. 43,66,558.15.2 (£291,103 18s. 7d.).

Since the close of the financial year a dividend of 5 annas per share, free of Indian tax, has been paid on Aug. 15, 1924, absorbing Rs. 42,31,777.13.0, and the directors recommend the payment on Feb. 16, 1925, of a further dividend of 6 annas per share, also free of Indian income tax.

The estimate of ore reserves at June 30 last was 4,514,797 tons, assaying 22.5 oz. silver, 25.2 per cent lead, 16.6 per cent zinc, compared with 4,511,909 tons, assaying 22.8 oz. silver, 25.3 per cent lead and 16.9 per cent zinc twelve months before, or an increase of 2,888 tons, notwithstanding the extraction of 277,231 tons during the year. For the reasons stated in the general manager's report, the copper ore is not shown separately on this occasion.

The railway is now carrying a tonnage considerably in excess of that which was thought possible a few years ago.

During the year the labor force at the mine has undergone a great change: A larger number of Indians are now employed underground and have adapted themselves to this class of work to a greater extent than had previously been anticipated. At the present time the Chinese do not constitute much more than half of the total force employed. The number of shifts worked shows an increase of 35.6 per cent, and, although this satisfactory increase is composed almost entirely of unskilled recruits, the efficiency has improved slightly, thus reflecting the benefit of the better supervision made possible by an increase in the European staff.

The following tables illustrate the progress made under the present program of operations inaugurated by the board in 1920, and which has been steadily pursued since that date:

		Production				
Period Ended	No. of Months	Ore Mined, Tons	Refined Lead, Tons	Fine Silver, Oz.	Working Rs.	Profit £
December, 1921	12	144,089	33,694	3,540,812	74,67,103	497,807
December, 1922	12	172,017	39,213	4,191,819	1,00,05,238	667,016
June 1923	6	118,572	21,654	2,266,874	61,81,133	412,076
June, 1924	12	277,231	47,109	5,114,721	1,61,01,080	1,073,405

In addition to the above, the following tonnages of antimonial lead, zinc concentrates and copper matte were produced during the periods ending June, 1923, and June, 1924:

	Period Ended	
Products	June, 1923 Tons	June, 1924 Tons
Antimonial lead	435	1,073
Zinc concentrates	855	12,364
Copper matte	...	2,340

In outlining their program the board indicated the intention to reduce the grade of ore extracted to the average of the ore reserves. The following table shows that this has been effected:

	Average Value of Ore Extracted			
Period Ended	Silver, Oz.	Lead, Per Cent	Zinc, Per Cent	Copper Per Cent
December, 1921	30.5	32.8	20.2	0.10
December, 1922	25.7	28.3	17.3	0.20
June, 1923	20.7	23.6	15.7	0.15
June, 1924	22.9	24.8	15.7	0.67
Ore reserves, June, 1924	22.5	25.2	16.6	1.3

Santa Gertrudis Co., Ltd.

A report of the operations of the Santa Gertrudis Co., Ltd., for the quarter ended Sept. 30, 1924, states that the mill, during this period, crushed 4,391 dry, short tons of ore from the Santa Gertrudis mine. The financial statement follows:

	United States Currency
Value of bullion produced	$36,892
Less working expenses (including development and shipping and selling)	31,133
Estimated profit at mines	$5,759

In addition to the above-recorded tonnage, the mill crushed 154,009 dry short tons of ore delivered by the Inversiones company from its El Bordo, Malinche, and El Cristo mines, and by the Dos Carlos company from its Dos Carlos, Refugio y Virginia and Miniatura mines.

Hecla Mining Co.

A financial statement for the third quarter of 1924 of the Hecla Mining Co. is as follows:

Gross income		$736,892.09
Operating expenses	$331,790.76	
Taxes accrued	37,000.00	
Depreciation (estimated)	30,000.00	398,790.76
Net profit		$338,101.33
Tons mined		60,466
Pounds lead produced		9,985,100
Average lead price per lb., cents		8.04
Ounces silver produced		279,447
Average silver price		$0.70

Iron Cap Copper Co.

During the third quarter of 1924 the production of the Iron Cap Copper Co. was 1,283,250 lb. of copper, 21,558 oz. of silver and 67.12 oz. of gold. The company's income account follows:

Income for the quarter	$131,264.50
Expense for the quarter	141,356.80
Loss	$10,092.30

Mining Shares Go Begging

As an indication of the value of the stock of some mining companies whose shares are not commonly traded in, and as a warning to those who wish to "invest" their money in mining projects that are properly speculative, the following prices, established at a recent auction sale in New York, may be of interest. The last two stocks, of course, have a real value.

Company	Number of Shares	Price for Lot
Radium Co. of Colorado, com.	128	$1
Radium Co. of Colorado, pfd.	200	8
Scott Mining Syndicate, Inc.	805	25
Alaska Smelting & Refining, 7 per cent, pfd.	50	1
Calavada Copper Co.	1,000	2
Pacific Smelting & Mining Co.	800	2
Little Bell Consolidated Mining Co.	200	1
Goldfield Consolidated Mines	500	25
Butte & London Copper Co.	700	7
Confidence Gold Mines Corporation, notes	$1,300	5
Rio Nechi Gold Mining Co., 6 per cent notes	$1,000	1
Rio Nechi Gold Mining Co.	50	1
Reins Copper Co., of Butte	300	1
United Copper Co.	100	1
Branch Mint Mining & Milling Co., of Deadwood, S. D.	5,000	2
Illinois Zinc Co.	100	200
Phosphate Mining Co.	122	1,720

Mining Stocks

Week Ended November 29, 1924

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Alaska-Br. Col.	N. Y. Curb			*10	
Anaconda	New York	41⅝	38¾	41⅝	De.15, Ja.21, Q 0.75
Arcadian Consol.	Boston	1⅛	*87	1	
Ariz. Com'l.	Boston	11¼	10½	11¼	Jy.19, Jy.31 0.50
Calaveras	N. Y. Curb	3	2½	2⅝	
Calumet & Arizona	Boston	53½	51	53½	De.5, De.22 Q 0.50
Calumet & Hecla	Boston	164	152	162	My. 31, Jn. 16 0.50
Canario Copper	N. Y. Curb	4½	4½	4½	
Cerro de Pasco	New York	48⅞	47½	48⅝	Oc. 23, No. 1 1.00
Chile Copper	New York	34⅞	33½	34⅞	De.3, De.29, Q 0.62½
Chino	New York	28	24½	28	Sept., 1920 0.37½
Con. Coppermines	N. Y. Curb	3½	2⅞	3½	
Copper Range	Boston	27¼	25½	27	May, 1923 1.00
Crystal Copper	Boston Curb	*68	*65	*65	
Davis-Daly	Boston	*45	*45	*45	Mar., 1920 0.25
East Butte	Boston	4⅞	4⅜	4⅞	Dec., 1919 0.50
First National	Boston Curb	*39	*36	*37	Feb., 1919 0.15
Franklin	Boston	1	*70	*70	
Gadsden Copper	Boston Curb	*64	*63	*63	
Granby Consol.	New York	18¾	16⅝	18½	May, 1919 1.25
Greene-Cananea	New York	16⅝	15½	16½	Nov., 1920 0.50
Hancock	Boston			1	
Howe Sound	N. Y. Curb	2½	2½	2⅝	Ap.1,Ap.15, Q 0.05
Inspiration Consl.	New York	29⅞	27⅞	29⅞	De.20, Ja.7, Q 0.50
Iron Cap	Boston Curb	2¼	2¼	2½	May, 1923 0.15
Isle Royale	Boston	18½	16½	18½	Se. 1, Se. 15 0.50
Jerome Verde Dev.	N. Y. Curb	1	*95	*95	
Jib Consol.	N. Y. Curb	*42	*39	*42	
Kennecott	New York	50¼	48⅜	50¼	De.2, Ja.2, Q 0.75
Keweenaw	Boston	*90	*90	*90	
Lake Copper	Boston	1⅞	1½	1½	
Magma Copper	New York	37¾	35½	37¼	Jan., 1919 0.50
Mason Valley	N. Y. Curb	1⅜	1⅜	1½	
Mass Consolidated	Boston	1	1	1	Nov., 1917 1.00
Miami Copper	New York	22⅞	22¼	22⅞	No.1 No.15 Q 0.50
Mohawk	Boston	35	32½	35	Se. 22, Oc. 13 1.00
Mother Lode Coa.	New York	8¼	7⅜	8¼	Jn. 13, Jn. 30 0.37½
Nevada Consol.	New York	14½	14	14½	Sept., 1920 0.25
New Cornelia	Boston	21⅝	20¼	21⅝	No. 7, No. 24 0.25
New Dominion	N. Y. Curb			2½	
North Butte	Boston	3	2¾	3	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	1⅛	1⅛	1⅛	No.14, De.2 0.05
Old Dominion	Boston	23½	22½	23⅜	Dec., 1918 1.00
Phelps Dodge	Open Mar.	†106	†100		Se.20, Oc.1 Q 1.00
Quincy	Boston	24	22½	24	Mar., 1920 1.00
Ray Consolidated	New York	17	15	17	Dec., 1920 0.25
Ray Hercules	N. Y. Curb	*15	*15	*15	
St. Mary's Min. Ld.	Boston	38	36½	38	Ap.22, My.20 3.00
Seneca Copper	New York	1⅛	1⅛	1⅜	
Shannon	Boston	*90	*85	*90	Nov., 1917 0.25
Shattuck Arizona	New York	7⅜	6½	6⅞	Jan., 1920 0.25
Superior & Boston	Boston	1¼	1¼	1½	
Tenn. C. & C.	New York	8½	8	8⅜	De.31, Ja.15,Q 0.25
United Verde Ex.	N. Y. Curb	27¼	26½	27¼	Oc. 3, No. 1 0.50
Utah Copper	New York	81	79⅝	81	Se.15, Se.30,Q 1.00
Utah Metal & T.	Boston	*24	*15	*20	Dec., 1917 0.30
Victoria	Boston			1	
Walker Mining	N. Y. Curb	3	3	3	
Winona	Boston	*35	*35	*35	
NICKEL-COPPER					
Internat. Nickel	New York	25⅛	22⅛	24¼	March, 1919 0.50
Internat. Nickel pfd.	New York	91⅛	91⅛	91⅛	Oc.16, No.1, Q 1.50
LEAD					
Carnegie Lead & Zinc	Pittsburgh	4⅞	4⅜	4⅜	
National Lead	New York	162½	156	162½	De.12, De.31, Q2.00
National Lead pfd.	New York	116⅔	116⅓	116⅔	No.21,De.15,Q 1.75
St. Joseph Lead	New York	39¼	37⅛	39	De. 9, De. 20 0.50
ZINC					
Am. Z. L. & S.	New York	9⅜	8⅞	9⅜	May, 1920 1.00
Am. Z. L. & S. pfd.	New York	32½	30½	32½	Nov., 1920 1.50
Butte C. & Z.	New York	8½	6¾	8⅛	De.10, De.24 0.50
Butte & Superior	New York	19⅞	17	19⅛	June, 1924 0.50
Callahan Zn-Ld.	New York	4	3½	4	Dec., 1920 0.50
New Jersey Zn.	N. Y. Curb	182	180	180½	Oc.,No.,'24 QX 4.00
United Zinc	N. Y. Curb			*25	
Yellow Pine	Los Angeles	*57½	*57½	*57½	June, 1924 0.04
SILVER					
Alvarado	Boston Curb			1⅜	
Beaver Consol.	Toronto	*23½	*20	*23	May, 1920 0.03
Castle-Trethewey	Toronto	*73	*71	*72	
Coniagas	Toronto	2.25	2.25	2.25	Ap.20, My.1 0.02½
Crown Reserve	Toronto	*50	*49½	*49½	Jan., 1917 0.05
Keeley	Toronto	2.23	2.20	2.22	Sept. 15, SA 0.12
Kerr Lake	N. Y. Curb	2	1⅞	1⅞	Oc. 1, Oc. 15, 0.12½
La Rose	Toronto	*6	*5	*5½	Apr., 1922 0.10½
Lorrain Trout Lake	Toronto	1.38	1.33	1.35	
McKinley-Dar.-Sav.	Toronto	*10½	*10	*10	Oct., 1920 0.03
Mining Corp. Can.	Toronto	2.72	2.50	2.65	Sept., 1919 0.12½
Nipissing	N. Y. Curb	6⅛	6⅛	6⅛	Oc.1,Oc.20,QX 0.30
Ontario Silver	New York			7	Jan., 1919 0.50
Temiskaming	Toronto	*19½	*19½	*19½	Jan., 1920 0.40
GOLD					
Alaska Gold	New York	*14	*12⅛	*12⅛	
Alaska Juneau	New York	1⅛	1	1⅛	
Argonaut	Toronto	*21½	*21	*21	
Carson Hill	Boston	*77	*60	*75	
Cresson Consol. G.	N. Y. Curb	3¼	3⅛	3⅛	De.31, Ja.10 Q 0.50
Dome Mines	New York	14⅜	13⅛	13⅞	De.31, Ja.20, Q 0.50
Golden Cycle	Colo. Springs	1.38	1.37	1.38	My.31, Jn.10 Q 0.03
Hollinger Consol.	Toronto	14.50	13.80	14.45	No.13, De.1, 0.05
Homestake Mining	New York	41½	41⅛	41⅜	No.2, No.25,M 0.50
Kirkland Lake	Toronto	*25½	*24	*25½	
Lake Shore	Toronto	4.18	3.98	4.15	De.1,De.15,QX 0.10
McIntyre-Porcupine	New York	15¼	15⅛	15¼	No. 1, De. 1 0.25
Newray	Toronto	*24½	*24	*24	
Portland	Colo. Springs	*50	*49	*50	Oct., 1920 0.01
Teck-Hughes	Toronto	1.17	1.15	1.16	
Tom Reed	Los Angeles	*21¾	*20	*20	Dec., 1919 0.02
Tough-Oakes	Toronto	*41	*39	*40	
United Eastern	N. Y. Curb	*38	*38	*38	Jy.18, Jy.31, Q 0.05
Vipond Cons.	Toronto	1.25	1.23	1.24	
Wright-Hargreaves	Toronto	3.80	3.78	3.79	Se.15,Oc.1, Q 0.02½
GOLD AND SILVER					
Black Oak	N. Y. Curb			*89	
Con. Cortez	N. Y. Curb	*12	*10	*11	
Con. Virginia	San Francisco	5½	5¼	5½	
Continental Mines	N. Y. Curb			1½	
Dolores Esperanza	N. Y. Curb	*31	*31	*31	Jy.1, Jy.10 Q 0.05
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅜	Se. 25, Oc. 30 0.08
Tonopah Belmont	N. Y. Curb			*55	Apr., 1923 0.05
Tonopah Divide	N. Y. Curb	*18	*18	*18	Se. 22, Oc. 10 0.10
Tonopah Extension	N. Y. Curb	3¼	2 13/16	3	De.11, Ja.1 0.05
Tonopah Mining	N. Y. Curb	1⅝	1⅝	1⅞	Se.20, Oc.31 0.07½
Unity Gold	N. Y. Curb	*90	*87	*90	
West End Consol.	N. Y. Curb	*50	*47	*50	Mar., 1923 0.05
Yukon Gold	N. Y. Curb			*50	June, 1918 0.02
SILVER-LEAD					
Ahumada	Boston Curb	6⅞	6⅜	6⅜	Se.16, Oc.2, X 0.15
Bingham Mines	Boston	21	20	21	Sept., 1919 0.25
Cardiff M. & M.	Salt Lake	1	*95	1	De.16, No.18 0.10
Chief Consol.	Boston Curb	3⅜	3 7/16	3⅜	Ap.19, My.1,Q 0.10
Columbus Rexall	Salt Lake	*29	*26	*26	Aug., 1920 0.03
Consol. M. & S.	Montreal	48	45½	46½	Jn.30, Jy.15 0.75
Daly Mining	Salt Lake			2.00	July, 1920 0.10
Erupcion	Boston Curb	2⅛	2 1/16	2⅛	Se. 15, Oc. 2, X 0.15
Federal M. & S.	New York	16⅛	15⅛	16⅛	Jan., 1909 1.50
Federal M. & S. pfd.	New York	55¼	53	54½	No.25, De.15, 1.75
Florence Silver	Spokane	6⅛	5⅛	6⅛	Apr., 1919, QX 0.01
Hecla Mining	N. Y. Curb	*10	*10	*10	No.15, Dn.15 0.25
Iron Blossom Con.	N. Y. Curb			*28	Oc.25, 1924 0.02½
Marsh Mines	N. Y. Curb			*5	June, 1921 0.02½
Park City	Salt Lake			4.65	Se. 15, Oc. 1 0.15
Park Utah	N. Y. Curb			3½	Mc. 15, Ap. 1 0.15
Prince Consol.	Salt Lake	*14	*11	*13	
Silver King Coa.	Salt Lake	5.15	4.95	5.10	Oct., 1924 0.15
Silversmith	Spokane	*28	*27	*27½	Oc. 1, Oc. 10 0.01
Tamarack-Custer	Spokane	1.36	1.30	1.36	Se. 22, Se. 29 0.25
Tintic Standard	Salt Lake	8.75	8.50	8.75	Se.1, '24, X 0.25
Utah-Apex	Boston	3⅝	2⅝	3⅛	Se.5, Se.15, Q 0.25
IRON					
Bethlehem Steel	New York	50	44	49½	Jn.1, Jy.1, Q 1.25
Char. Iron	Detroit	*30	*25	*25	
Char. Iron pfd.	Detroit	*70	*70	*70	
Colorado Fuel & Iron	New York	41¼	37¼	41	Au.11, Au.25,Q 2.00
Col. Fuel & Iron pfd.	New York			108¼	No.10, No.26 Q 2.00
Gt. North'n Iron Ore	New York	39⅜	36⅜	38½	De.10, De.27 2.00
Inland Steel	N. Y. Curb			4	No.14, De.1, Q 0.62½
Mesabi Iron	N. Y. Curb			2¼	
Replogle Steel	New York	23½	15½	22½	
Republic I. & S.	New York	54⅜	48	54½	May, 1921 1.50
Republic I. & S. pfd.	New York	92⅜	90½	92⅛	De.16, Ja.2, Q 1.75
Sloss-Sheffield S. & I.	New York	82¼	7›	81⅜	Se.11, Se.20, Q 1.50
Sloss-Shef. S.&I. pfd.	New York	91⅛	91	91⅛	De.9, De.20, Q 1.75
U. S. Steel	New York	119⅛	115½	117½	No.29,De.3, QX 1.75
U. S. Steel pfd.	New York	122	121	122	No.4, No.29, Q 1.75
Virginia I. C. & C.	New York			45	De.15, Ja.2 1.50
Virginia I.C.&C.pfd.	New York	77½	77½	77½	De. 13, Ja. 2, Q 2.50
VANADIUM					
Vanadium Corp.	New York	30⅜	27	30½	Jan., 1921 1.00
ARSENIC					
Western Utah Copper	N. Y. Curb			*19	
ASBESTOS					
Asbestos Corp.	Montreal			30	Se.29, Oc.15 Q 1.00
Asbestos Corp. pfd.	Montreal			70	Oc.1, Oc.15, Q 1.50
SULPHUR					
Freeport Texas	New York	12⅛	8⅛	11⅛	Nov., 1919 1.00
Texas Gulf	New York	99⅜	87½	97⅜	De.1,De.15, QX 2.25
PLATINUM					
So. Am. Gold & P.	N. Y. Curb	4⅛	3⅛	3½	
MINING, SMELTING AND REFINING					
Amer. Metal	New York	49½	48¾	49⅛	No.19, De.1 Q 0.75
Amer. Metal pfd.	New York			113	No.20, De.1, Q 1.75
Amer. Sm. & Ref.	New York	87⅞	84	87⅛	Oc.17, No.1, Q 1.25
Amer.Sm.&Ref.pfd.	New York	105½	104	105¾	No.17, De.1 Q 1.75
U. S. Sm. R. & M.	New York	37⅞	35½	36¼	Jan., 1921 0.50
U.S. Sm. R.&M.pfd.	New York	46	45¼	46	Oc.9, Oc.15 Q 0.87

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.